JOURNAL OF THE SMPTE

129 **Five Papers on International Television and Bilingual Films**
Problems of International TV Broadcasting • *T. H. Bridgewater*—NARCOM Plan for Transatlantic Television • *William S. Halstead* — Methods of Translating Used in Bilingual Films • *Max G. Kosarin* — Case History of Bilingual Telecasting in Canada • *Jacques Landry* — Future Trends in Multi-Voice Films for International Television • *Leon Shelly*

144 Averaging Screen-Illumination Readings • *Armin J. Hill*

149 Beam-Landing Errors and Signal-Output Uniformity of Vidicons • *R. G. Neuhauser and L. D. Miller*

154 Improved Developmental One-Inch Vidicon for Television Cameras • *L. D. Miller and B. H. Vine*

157 A Stabilized Monitor for Color Television Picture Quality Control • *E. E. Gloystein and N. P. Kellaway*

163 Visual Amplification • *H. J. Schlafly*

164 Survey of Large-Screen Television Projection Equipment • *Frank N. Gillette*

166 Medium Screen Color Television Projection • *S. L. Bendell and W. J. Neely*

169 Preventing Formation of Newton's Rings During Contact Printing of Motion-Picture Film • *Charles E. Osborne*

172 A Silver-Recovery Apparatus • *Nicholas J. Cedrone*

175 Cold Mirrors for Projection Heat Control • *Balzers Laboratories*

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International Television and Bilingual Films

Any discussion of international television must take into account, either directly or by implication, its potential role in international politics and the possibility it holds for increased understanding and friendship among people now separated by language barriers. There are many problems that must be solved before international television can become an accepted part of the existence of these divergent cultural groups. Some problems are concerned with language, some with time differences, others with such matters as television-frame and line-rate compatibility, program scheduling and economics. The solution lies within the combined technical, linguistic and cultural areas. It is the purpose of the following five papers to describe the progress that has been, and is being, made toward the solution of these problems, particularly in the technical area. This group of papers was organized for the Society's Convention at Philadelphia in October 1957 and also presented before the SMPTE Washington Section in February 1958.—*Ellis W. D'Arcy*, Program Topic Chairman.

Problems of International Television Broadcasting

By T. H. BRIDGEWATER

The interchange of television programmes among European countries is called Eurovision. It is not a network or planned operation under a single control, but is essentially the use of a number of independent services and networks on a cooperative basis. This paper describes certain problems encountered in this interchange, such as noncompatible line structure and frame rate, relay time coordination and language problems, and the means of solution.

TELEVISION was introduced in the United Kingdom in 1936, but public television services in other European countries have been in existence, in accordance with present standards, only since World War II. Countries with public television now in operation are enlarging and expanding their facilities and coverage. Many countries do not have television while others can offer service only on an experimental basis. Countries with public television services in full operation which cooperate in Eurovision are: Austria, Belgium, Denmark, Federal German Republic, France, Holland, Italy, Luxembourg, Monaco, Switzerland and the United Kingdom.

Presented on October 8, 1957, at the Society's Convention at Philadelphia by K. R. Sturley for the author, T. H. Bridgewater, British Broadcasting Corp., London.
(This paper was received on October 7, 1957.)

Comparison Between Countries

The organisations controlling television in these countries vary considerably in constitution and financial structure. Some rely on commercial backing in exchange for advertising; others are public corporations obtaining income from licenses; others are government departments; and others combine elements of several systems. Moreover, the scope of these organisations varies greatly. In some countries it is obligatory for all vision and sound circuits to be leased from the government Postal and Telephone Department (P.T.T.) while in others the television organisation installs its own network. In some countries the television organisations own all the cameras and broadcast stations; in others some or all of such equipment may be operated by the P.T.T.

Unfortunately, one of the most significant differences of television organisation among European countries is in the area of technical transmission standards. For various reasons the early growth of European television was accompanied by changing ideas about optimum international standards. Recently there has been a fairly general adoption of the C.C.I.R. (Comité Consultatif International du Radio) or near-C.C.I.R. 625-line recommendation, but even so, certain newcomers, such as Monaco which is adjacent to an area where the 819-line standard was already widely established, have felt it necessary to adopt their neighbours' older standard or some close variant.

Apart from the actual number of lines, there are other differences between one standard and another, such as FM or AM sound and positive or negative vision modulation — some of which, although complicating in other directions (e.g. the design of receivers) may, however, not be impeding to the operation of Eurovision. The broad differences between systems and countries are summarised in Table I.

Table I. Comparison of Standards.

Country	No. of lines	Fields per sec.	Vision bandwidth mc/s	Sound modulation	Sound carrier relative to vision, mc/s	Sense of vision modulation	Synchronising waveform
U.K.	405	50	3	AM	− 3.5	P	British Standard
France	819	50	10.4	AM	−11.15	P	French Standard*
Luxembourg	819	50	5	AM	5.5	P	French Standard
Monaco	819	50	10.4	AM	−11.15	P	French Standard
Belgium (French Service)	819	50	5	AM	+ 5.5	P	C.C.I.R.
Belgium (Flemish Service)	625	50	5	AM	+ 5.5	P	C.C.I.R.
Holland	625	50	5	FM	+ 5.5	N	C.C.I.R.
Germany	625	50	5	FM	+ 5.5	N	C.C.I.R.
Denmark	625	50	5	FM	+ 5.5	N	C.C.I.R.
Austria	625	50	5	FM	+ 5.5	N	C.C.I.R.
Switzerland	625	50	5	FM	+ 5.5	N	C.C.I.R.
Italy	625	50	5	FM	+ 5.5	N	C.C.I.R.

* One-frame sync pulse only—no equalising pulses.

These differences when analysed signify five basic transmission standards (and even more if minor variations are taken into account) as shown in Table II.

Difference of the vision waveform, as distinct from those associated with the modulated carrier, are usually quite incompatible, and programme-sharing between countries of incompatible standards requires the interposition of a Standards Converter. Where there is a difference in the number of lines, a Converter is required to convert both picture and synchronising waveforms to the new standard, with the exception of exchanges between Standards 2 and 3, where the picture requires no conversion but the synchronising waveform needs replacing.

It has already been mentioned that an integral European network has never been planned comprehensively. Each country has, in fact, had to concentrate on building up its own domestic service and internal network. In this respect Eurovision has only been achieved by:

(a) The installation of linking circuits between neighbouring countries (though in the early stages there was some use of "ballemfang," or "rebroadcasting"); and

(b) the expansion of internal networks to provide a number of transit circuits to allow the passage of programmes other than those supplying the domestic network.

An important country-to-country difference that profoundly affects the exploitation of Eurovision is, of course, that of language. Six distinct languages are spoken by the people of the countries now participating in Eurovision and conversion in one form or another must be provided. The languages are English, French, German, Dutch and Flemish, Danish, and Italian.

Another difficulty, not so much a difference as a common factor, has been a pronounced reluctance on the part of the Trade Unions representing Actors and Musicians to enter into Eurovision before securing more favorable remuneration to their members. Negotiations are going on, but the embargo has restricted the types of programmes exchanged.

Differences and difficulties have been stressed; but, fortunately, there are at least two important features shared by all the countries: a 50 cycles/sec power frequency and (with the exception of the United Kingdom in the winter months, where the difference is one hour) a common time (Central European).

Table II. Basic Differences Between European Standards.

Standard	Country	Basic Standard	Remarks
1:	United Kingdom	405 lines	
2:	France	819 lines	
3:	Belgium (French Service)	819 lines	compared with France, has: (a) different (vis. C.C.I.R.) synchronising waveform; (b) narrower video band.
4:	Belgium (Flemish Service)	625 lines	compared with C.C.I.R. has (a) AM sound; and (b) positive vision modulation.
5:	Switzerland	625 lines	C.C.I.R.

These many variations in the form and standard of television between one European country and another, coupled with marked disparities in the state of growth of their respective services, call for the most meticulous international cooperation in both planning and exploitation in order to make possible effective interchanges of programmes. In fact, such cooperation between both engineering and programme staffs, at first on an informal basis and now fostered by the European Broadcasting Union, has been conspicuously generous and effective from the first occasion in 1952 when French programmes on 819 lines were simultaneously converted and rebroadcast in the United Kingdom on 405 lines.

The present state of the Eurovision Network is depicted in Fig. 1.

Standards Conversion

Converters are located at strategic points to ensure conversion whenever necessary but always strictly avoiding double conversion. For the usual cases where the number of lines differs, the converter consists of a complete television camera and waveform generator on the desired standard retaking pictures displayed before it on the original standard. The basic problems underlying this method have been described by A. V. Lord.* Types of pickup tube in use for this purpose are: image inconoscope, 3-in. image orthicon, $4\frac{1}{2}$-in. image orthicon, and vidicon.

So far, the most promising results have been achieved by the $4\frac{1}{2}$-in. image orthicon which is especially notable for low noise level and good resolution. The successful operation of Standards Converters calls for the utmost skill and care. The limited case of the conversion of the synchronising waveform only (between French and Belgian 819-line systems) is readily dealt with by a straightforward obliteration of one waveform and substitution by the other, without any disturbance to the picture.

The Vision Network

The Eurovision Network (Fig. 1) includes national networks, transit circuits and international linkages. All the circuits comprise radio (ultra-high-frequency and super-high-frequency) links. Some are permanent, while others are still provisional and may make use of ordinary portable demodulating equipment. The numbers of transit circuits are still restricted and so in some cases a programme can only be passed through an intervening country provided that country itself also agrees to use the same programme, or, alternatively, its internal network is out of use at the time.

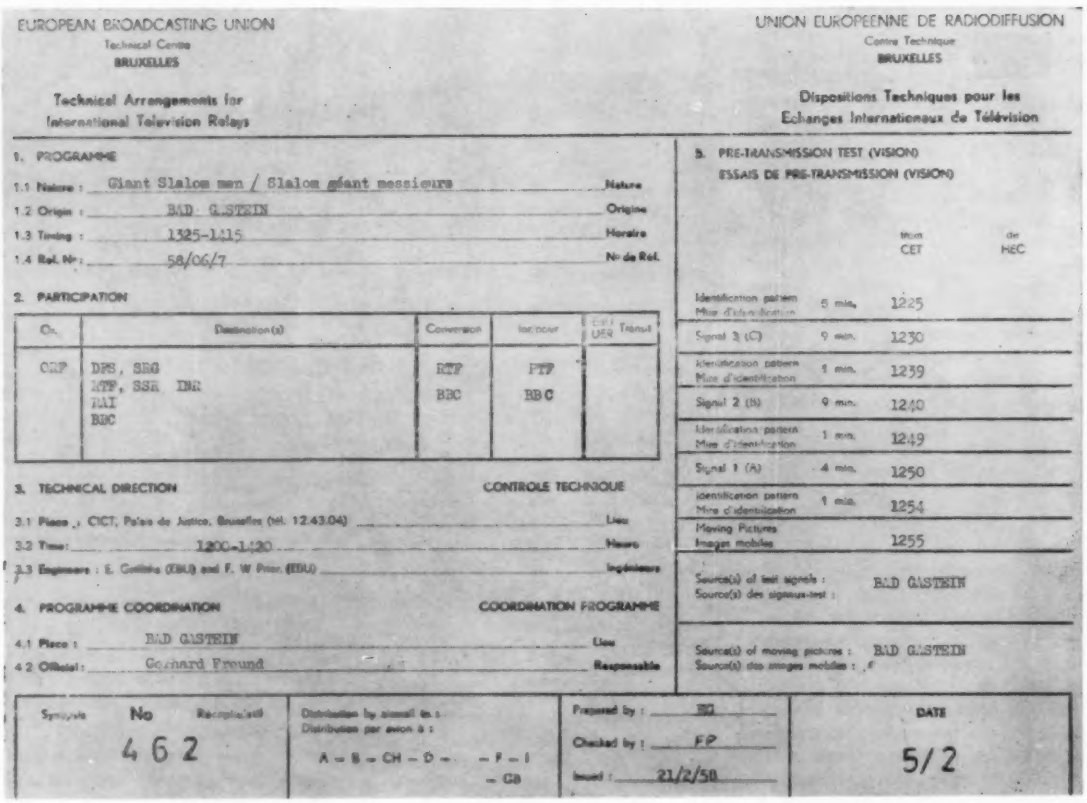
* A. V. Lord, "Standards converter for international TV," *Electronics, 26:* 144–147, Aug. 1953 (also *BBC Quarterly, 8:* No. 2, 1955).

Fig. 1. The Eurovision Network as of December 1957.

The majority of these circuits are owned and operated by P.T.T. administrations but a considerable number are in the hands of broadcasting organisations (in Belgium, Italy and parts of France).

Language Differences: Sound

The majority of exchange programmes are of actualities or events requiring a commentator. For Eurovision it therefore becomes necessary to arrange at least as many commentaries as there are languages spoken in the countries receiving any particular programmes. This may mean, for example, six commentators at the site of the broadcast, which, together with all the associated communication and control arrangements, results in a degree of complexity that often renders the handling of the sound side of Eurovision more difficult or uncertain than the vision counterpart. Indeed, the new demand for increased numbers of high-quality sound circuits has been temporarily straining the European P.T.T. resources. Occasionally a commentary may be made "off the screen" at the receiving end but this is by no means easy to do effectively. It is usual for the sound "effects" to be separated from the commentary and only mixed at the receiving end: this has the advantage both of economizing in high-quality circuits and also of avoiding the complications of controlling and



EUROPEAN BROADCASTING UNION
Technical Centre
BRUXELLES

UNION EUROPEENNE DE RADIODIFFUSION
Centre Technique
BRUXELLES

Technical Arrangements for International Television Relays

Dispositions Techniques pour les Echanges Internationaux de Télévision

1. PROGRAMME

1.1 Nature : Giant Slalom men / Slalom géant messieurs — Nature
1.2 Origin : BAD GASTEIN — Origine
1.3 Timing : 1325-1415 — Horaire
1.4 Ref. Nr : 58/06/7 — N° de Réf.

2. PARTICIPATION

Or.	Destination(s)	Conversion	for/pour	EBU/UER Transit
ORF	DFS, SRG RTF, SSR, INR RAI BBC	RTF BBC	PTP BBC	

3. TECHNICAL DIRECTION — CONTROLE TECHNIQUE

3.1 Place : CICT, Palais de Justice, Bruxelles (tel. 12.43.04) — Lieu
3.2 Time : 1200-1420 — Heure
3.3 Engineers : E. Gallois (EBU) and F. W. Prior (EBU) — Ingénieurs

4. PROGRAMME COORDINATION — COORDINATION PROGRAMME

4.1 Place : BAD GASTEIN — Lieu
4.2 Official : Gerhard Freund — Responsable

5. PRE-TRANSMISSION TEST (VISION)
ESSAIS DE PRE-TRANSMISSION (VISION)

		from CET	de HEC
Identification pattern / Mire d'identification	5 min.	1225	
Signal 3 (C)	9 min.	1230	
Identification pattern / Mire d'identification	1 min.	1239	
Signal 2 (B)	9 min.	1240	
Identification pattern / Mire d'identification	1 min.	1249	
Signal 1 (A)	4 min.	1250	
Identification pattern / Mire d'identification	1 min.	1254	
Moving Pictures / Images mobiles		1255	

Source(s) of test signals / Source(s) des signaux-test : BAD GASTEIN

Source(s) of moving pictures / Source(s) des images mobiles : BAD GASTEIN

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Synopsis No 462 Page 2

6. VISION AND SOUND REQUIREMENTS — DISPOSITIONS A PRENDRE POUR LA VISION ET LE SON

Ordered by : Commandé par : (i)	VISION Source (ii)	VISION Circuit (iii)	VISION Del. (iv)	Tech. Coord. Circuit(s) Bruxelles to : Bruxelles à : (v)	SOUND - SON Source (vi)	SOUND - SON Comm. from Comm. de (vii)	SOUND - SON Inser. Snd. from Son Inter. de (viii)	SOUND - SON Comp. Prog. from Prog. Comp. de (ix)
EBU/UER (B)				BAD GASTEIN CROSSER FELDBERG UETLIBERG PARIS MILANO LONDON 1220-1420				
DFS (D)	OR	SALZBURG-MUENCHEN 1225/1255/1325-1415	625		GERMAN COMM.	---	---	BAD GASTEIN 1255/1325-1415
SRG (CH)	DFS	HOHNISGRINDE -UETLIBERG 1225/1310/1325-1415	625		DFS	---	---	BADEN BADEN 1255/1325-1415
SSR (CH)					COMM FRANCAIS	--	---	BAD GASTEIN 1255/1325-1415
RTF (F)	DFS	HORNISGRINDE - (DABO) -PARIS 1225/1255/1325-1415	625/819		COMM. FRANCAIS	---	---	GENEVE 1255/1325-1415
INR (B)	DFS	KOELN-BRUXELLES 1225/1255/1325-1415	625		COMM. FRANCAIS	--	---	PARIS 1255/1325-1415
RAI (I)	DFS	UETLIBERG-MILANO 1225/1310/1325-1415	625		PROPRE COMM.	---	---	BAD GASTEIN 1255/1325-1415
BBC (GB)	DFS	BRUXELLES-(LILLE) 122[illegible]/1325-1415	625/405		OWN COMM.	---	---	BAD GASTEIN 1255/1325-1415
RTF (F)		Transit pour la BBC						5/2

Fig. 2. Synopsis of Requirements compiled and issued by the E.B.U. Technical Centre.

mixing a large number of foreign-language commentaries at the point of origin.

Coordination

The clue to the successful operation of Eurovision has lain largely in the remarkable measure of international cooperation and coordination that has always been devoted to this enterprise. As mentioned earlier, the E.B.U. has been the means of further uniting broadcasters and P.T.T. administrations in the common aim. Regular international meetings are held of Programme and Technical Committees and Subcommittees to discuss longer-term planning requirements as well as month-to-month arrangements, operational procedure, technical standards, tests, etc. In addition, special Technical and Programme Control Centres have been set up to deal with the programme exchanges as they take place — in particular:

A National Technical Control Centre (N.T.C.C.) in each country;

A National Programme Control Centre (N.P.C.C.) in each country; and

An International Technical Control Centre (I.T.C.C.) at Brussels.

The first two above are usually, and preferably, at one and the same point. The last mentioned is located at a conveniently strategic point on the network (in fact, the roof of the Palais de Justice, Brussels) and is maintained and operated by the E.B.U. Technical Centre whose headquarters are also at Brussels.

Each of the N.T.C.C.'s and N.P.C.C.'s are answerable for, and in direct control of, all technical and programme arrangements (including conveyance along the network to the boundary hand-over points). They are each in continuous link by telephone with the I.T.C.C. and the latter exercises complete control over the vision network as a whole, ensuring that each country fulfills the role assigned to it (including the operation of converters when appropriate) in accordance with a previously prepared Synopsis of Requirements (Fig. 2). This Synopsis is compiled and issued by the E.B.U. Technical Centre on the basis of programme arrangements submitted beforehand by the participating countries.

Fig. 3. Very acceptable example of Eurovision's technical performance and reliability, even after conversion from 405 lines to 819 lines.

Summary

Eurovision is growing fast, and the many difficulties — technical, political, economic and lingual — are being overcome through goodwill and cooperation. The numbers and kinds of exchanges are increasing and the improvements in technical resources permit the choice of (1) multilateral exchanges where one, two or more countries share the programme being broadcast in another; and (2) unilateral exchanges where one, two or more countries share a programme that is being specially produced in another country but not broadcast in that country.

In addition, there are variations, such as two-way simultaneous transmissions, that are sometimes possible.

The technical performance and reliability are becoming very satisfactory and, even after conversion, entirely acceptable pictures are usually obtainable (Fig. 3). Eurovision has become quite an every-day affair in the homes of many peoples of Western Europe. The extension of Eurovision to other Western countries and to Eastern Europe seems only a matter of time. The Eastern European problem is partly political, partly technical. The Iron Curtain countries are somewhat behind in their television development, although limited services have started in many of them. Considerable distances are involved. The distance from Berlin to Moscow exceeds 1,000 miles. There is also the problem of the international organisation and cooperation, so essential to success, which has yet to be resolved and which is rendered the more difficult by the abstention from E.B.U. membership of all Iron Curtain countries. However, that such cooperation is not impossible has already been demonstrated by the exchanging of Eurovision programmes with Czechoslovakia on two occasions in the past eighteen months.

The NARCOM Plan for Transatlantic Television and Other Wideband Telecommunication Services

By WILLIAM S. HALSTEAD

A proposed North Atlantic Relay Communication System (NARCOM) is discussed in detail. A plan for linking the United States and Canada to Great Britain and Europe, using this system, has been presented to the European Broadcasting Union.

THE DESIRABILITY OF linking the United States and Canada with Great Britain and Europe is unquestioned although technical obstacles to this goal have delayed its accomplishment. The present transatlantic cables and radio systems have bandwidth limitations and present other technical obstacles to successful use for video transmission.

A radio-wave transmission method, tropospheric-scatter propagation, has been evolved within the past several years and is now in successful use in wideband communication relay systems extending over transcontinental distances. This communications method may prove to be a long-range solution to many current problems in the international telecommunication field and it may well become a new tool with which television and other wideband signals may be exchanged between continental areas.

With systems of this type, now in operation over long distances in the North American defense network, a single wideband carrier in the ultra-high-frequency (UHF) band above 300 mc can simultaneously accommodate a traffic load substantially greater than can be handled by all of the transatlantic radio and cable circuits now in use. Moreover, the new systems appear to function most effectively in the upper portions of the radio spectrum above 500 mc where there is ample room for television and other broadband services.

Unlike conventional shortwave radio methods now employed in long-range services, the tropospheric-scatter systems utilize the earth's atmosphere in traversing a path between relay stations spaced up to several hundred miles apart. Radio-wave energy is concentrated in extremely narrow beams, usually less than one or two degrees in width, by means of large-diameter parabolic antenna structures (Fig. 1) which can readily provide power gains in excess of 10,000 times at frequencies above 500 mc. With such antennas, and the use of high-power transmitters, generally of wideband frequency-modulation type, effective radiated power of the order of 500 megawatts or more can be obtained. The wave energy then is directed along a path in the atmosphere extending far beyond the horizon, in some cases over distances of 200–400 miles.

Under theories now accepted, scattering of the radio waves by discontinuities or turbulence in the upper regions of the atmosphere causes a portion of the transmitted signal energy to be returned to earth at beyond-horizon distances.[1] The signals may there be detected by sensitive receivers with associated high-gain antennas. The overall scattering effect is somewhat analogous to that often observed in misty air when a beam of light from a distant searchlight may be seen clearly by an observer on the ground below the beam, although the source of light itself is not visible.

Development of Tropospheric-Scatter Techniques

As early as 1930, Marconi reported to the Italian Society for the Progress of Sciences that he had accomplished successful radiotelephone transmission at very high frequencies above 30 mc on over-water paths extending for distances up to approximately 160 statute miles.[2] Radio-beam techniques were used, employing high-gain directional antennas, with effective radiated power of 40 kw. By beam-swinging experiments, Marconi had determined in this pioneering work in beyond-horizon radiotelephony that the angle of arrival of the VHF signals was tangential to the horizon, indicating that the signals did not follow the propagation paths normally associated with conventional short-wave transmission methods. He therefore concluded in his address to the Italian Society that the wave-propagation path was "contained within a space lying between the surface of the earth and a layer somewhat lower than the Heaviside layer."

In 1932, Marconi carried his beyond-horizon propagation tests to the UHF band above 300 mc. Using parabolic antennas to develop narrow radio beams, he succeeded in transmitting frequency-modulated radiotelephone signals at a carrier frequency of 600 mc over distances of 168 miles.[3] Marconi again noted that the angle of arrival of the signal was tangential to the horizon, and that the signals were always present, though subject to deep fading. He expressed the conviction that the ability of the very short waves to traverse distances far beyond the horizon could be attributed to the effects of the lower atmosphere, and that eventually distances of the order of 250–300 miles could be spanned.[4]

Fig. 1. Paraboloid antenna, 60 ft in diameter, employed in wideband relay system of United States-Canada defense network in Arctic area. (Courtesy of D. S. Kennedy & Co., Cohasset, Mass.)

Aside from Marconi's early pioneering work in beyond-horizon transmission by radio-beam methods at frequencies above 30 mc, little organized work was carried out by others in this field until approximately twenty years later. In 1950, Irvin H. Gerks, of Collins Radio Company, reported on the results of propagation tests over beyond-horizon paths at an ultra-high frequency of 412 mc.[5] Gerks employed a 30-kw transmitter, with parabolic antennas having power gains of 28 db at the transmitter and 20 db at the receiver. He expressed the opinion that "quite effective use can be made of the scattered wave to a distance of 200 miles."

In 1953, Kenneth Bullington summarized the results of tropospheric-propagation tests conducted by Bell Telephone Laboratories over beyond-horizon distances at carrier frequencies of 460 mc, 535 mc, and 3700 mc.[6] The data indicated, among other findings, that median signals in the 300–4000-mc band as received at 300 miles were approximately 85 db below free space. Bullington stated in his conclusions that "high transmitter power and large antennas are needed to obtain reliable voice channels over distances of 200 miles or more. The high-gain antennas needed at both transmitter and receiver indicate that the most likely application of long-path ranst-

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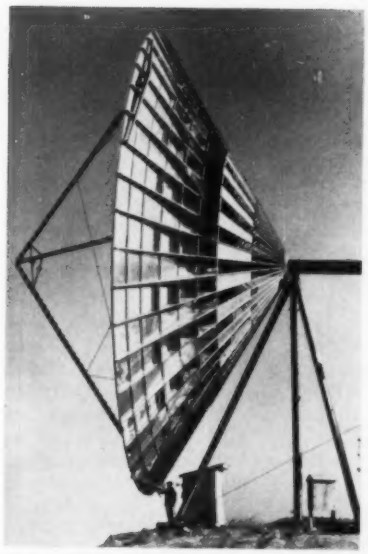

Fig. 2. Sixty-foot experimental antenna, located on a hill at Holmdel, N. J., used for super-high frequencies, which can pick up television and telephone signals sent directly through space for 200 miles. (Courtesy of the Bell Telephone Laboratories, Inc.)

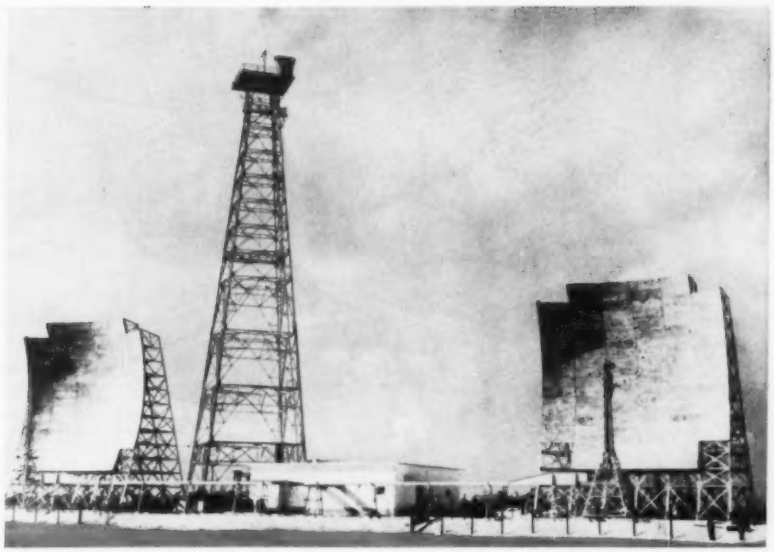

Fig. 3. Square 60-ft reflectors which transmit and receive signals flashed "over the horizon" between Florida City, Fla., and Guanabo, Cuba. This system is operated jointly by American Telephone and Telegraph Co. on the Florida side, and by International Telephone and Telegraph Corp. at the Cuba terminus. (Courtesy of the American Telephone and Telegraph Co.)

mission will be for point-to-point service over difficult terrain."

In addition to the work of Bell Telephone Laboratories on beyond-horizon propagation at the higher radio frequencies, many other organizations, including the Central Propagation Laboratory, FCC, Lincoln Laboratory of M.I.T., and radio equipment manufacturers have made significant contributions to the art in recent years, leading to the rapid evolution of today's long-range tropospheric-scatter transmitting and receiving equipment.

Wideband Signal Transmission Systems

Because of the improved transmission characteristics of the tropospheric-scatter systems in operating over long distances, it was natural that the wideband potentials of these systems would be explored. Work was carried out by Bell Telephone Laboratories in cooperation with Lincoln Laboratory, M.I.T., in 1953–54 to test the potential capability of these systems in accommodating wideband signals, such as those required for multichannel telephony, very high-speed facsimile or telephoto, and television services. In 1955, Bell Telephone Laboratories reported on the results of these tests over a radio path of 188 miles in length between Holmdel, N.J., and the Round Hill field station of M.I.T. at South Dartmouth, Mass.[7] The tests included the transmission of television signals on beyond-horizon ultra-high frequency and super-high frequency (SHF) circuits.

The SHF transmitter at Holmdel supplied a power output of about 300 w, at a carrier frequency of 5050 mc. Twenty-eight-foot parabolic antennas were used at each end of the circuit. The receiver provided a maximum bandwidth capability of 30 mc. Frequency modulation of the SHF carrier was utilized, with frequency deviation of ± 4 mc. Total bandwidth occupancy with modulation during transmission of picture signals was in the range of 12 to 16 mc. Median carrier-to-noise ratios of 18 to 24 db were obtained over the 188-mile path, resulting in excellent picture quality at the receiver.

Bell Laboratories concluded, from these initial tests, that "bandwidths capable of transmitting television pictures are available on beyond-horizon UHF and SHF circuits, providing high transmitter power and narrow beam antennas are used." Subsequently, a 60-ft parabolic antenna, shown in Fig. 2, was installed at Holmdel for further tests on the wideband capabilities of beyond-horizon systems.

In the fall of 1957 the International Telephone and Telegraph Corporation in association with American Telephone and Telegraph Co. inaugurated the first international television relay system employing tropospheric-scatter propagation. This is now in successful commercial operation between a UHF over-horizon relay station at Florida City, Florida (Fig. 3), and a location in the vicinity of Havana, Cuba — an airline distance of 185 miles. This system has exceeded original performance characteristics and has demonstrated that tropospheric-scatter systems are capable of providing sustained high-quality, wideband operation in commercial services, including television relaying.[8,9]

The Florida-Cuba UHF relay system employs two 60-ft parabolic antennas at each station (shown in Fig. 3) fed by 10-kw transmitters of wideband FM type. Operation of the system is in the 680–900-mc band. Frequency deviation of ± 1 mc is utilized as optimum. The receiving system permits dual or quadruple diversity by combining the received signals at intermediate frequency. Overall 1-db bandwidth is 15 mc, providing space for 120 to 600 telephone channels or for TV program transmission. Median radio-frequency signal-to-noise ratio is about 47 db when equipment is adjusted to bandwidth of 11 mc. With the 47-db signal-to-noise ratio, the base band video signal-to-noise ratio is 48 db on the basis of peak-to-peak signal to rms noise.

Telephone and television signals may be transmitted simultaneously by using dual diversity with separate carrier frequencies. Interconnection with existing networks of American Telephone and Telegraph Co. and the Cuban telephone system is in Florida and Cuba, respectively, by means of standard TD-2 microwave relay links, with line-of-sight spacing between stations. Path loss between the UHF stations is 197 db. With 120 telephone channels, using frequency-division multiplex, the noise on each channel has been measured at about 22 db at zero level, which is about 10 db better than design objective for telephone circuits of this length. Reliability is such that the received signal is above the FM threshold

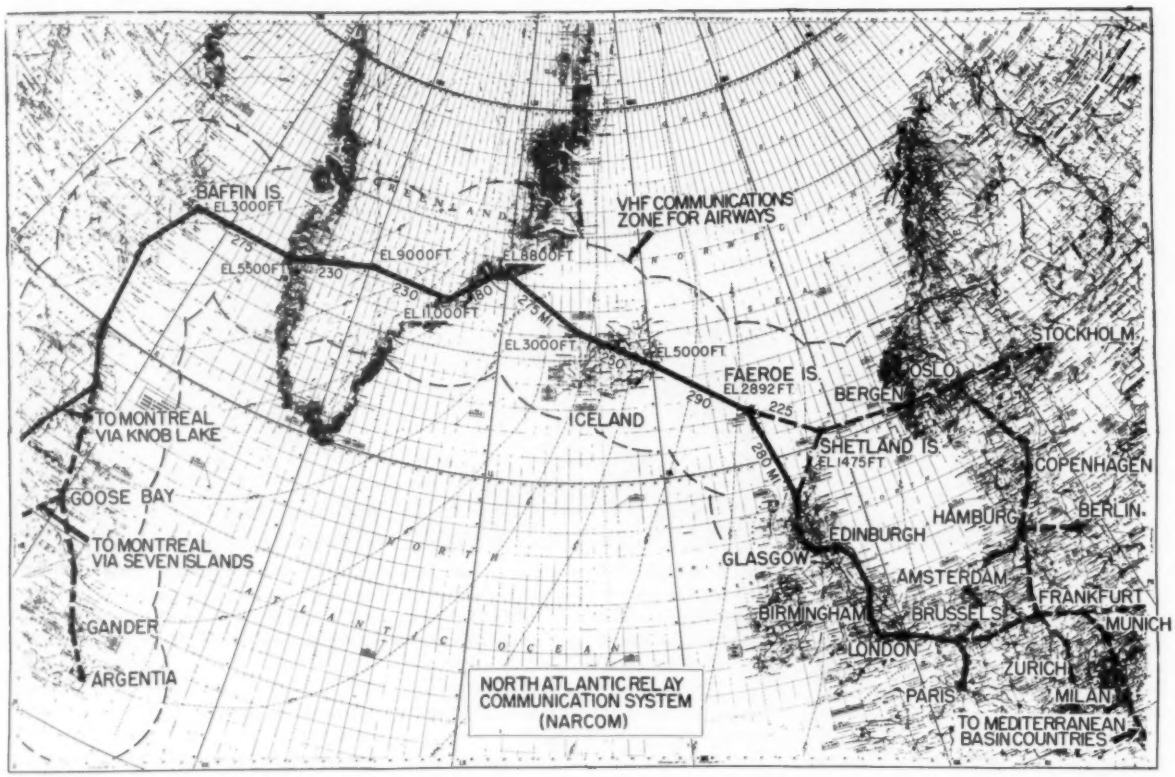

Fig. 4. NARCOM route map between North America and Europe.

99.9% of the time. Noise-loading distortion products are more than 50 db below signal level.[9]

The experience derived from tropospheric scatter systems now in operation such as the Florida-Cuba link, demonstrates that they are reliable, and relatively free of the destructive fading, multipath distortion and severe interference conditions that often disrupt shortwave radio services. Hence, they may bring about revolutionary changes in the field of international telecommunication.[10]

The significance of tropospheric-propagation methods as applied to transatlantic communication services, including international television and high-fidelity FM radio broadcasting, becomes apparent when it is realized that the longest over-water distance between possible relay sites on the island chain across the North Atlantic, comprising Baffin Island, Greenland, Iceland, the Faeroes and the British Isles, is approximately 290 miles.

From performance data contributed by operation of typical long-range scatter systems in North America, it can be predicted that a reliable service with video bandwidths can be maintained over the paths between relay stations on the islands extending across the North Atlantic (Fig. 4) if there is adequate power at transmitting sites and if natural elevated sites, such as mountains on the islands in the transatlantic chain, are used to the maximum advantage.

Proposed NARCOM Route

The route of the proposed North Atlantic Relay Communication System, termed NARCOM, would follow a northerly course between the United States and Greenland. The route would then veer in an eastward direction toward Europe, with branches from the Faeroes extending southward to Great Britain and eastward to the Scandinavian countries and central Europe.

Preliminary system plans for the NARCOM route are based on the use of microwave-relay or coaxial-cable circuits between New York City and Seven Islands, Quebec, at the mouth of the St. Lawrence. From this point, it is proposed that high-power UHF relay stations be employed in the circuit to the mining-railroad terminus at Knob Lake, Labrador; and over Baffin Island, Southern Greenland, Iceland, and the Faeroe Islands to the British Isles, where connections would be made with existing microwave and coaxial-cable systems. On the European end of the system, the relay circuit may branch to the Scandinavian countries where connections could be made with existing radio-relay and cable systems of Central Europe.

It is proposed to use at least one relay station at a point on the Greenland icecap about midway between the two coasts. This station, and others joined in the relay network on the transatlantic route, would be in a strategic position to provide data on weather conditions and storm forecasts of value to European countries, international airways and shipping, as well as multichannel relay facilities for airway communication and navigational services.

It is estimated that a relay chain consisting of a minimum of 15 UHF relay stations, employing wideband FM transmitters with power outputs in the range of 25–50 kw, will be required in the portion of the relay system extending between Seven Islands and Northern Scotland. The total path length is approximately 3300 miles, with a minimum of fourteen hops, averaging 235 miles in length.

Communication engineers who are familiar with these northern areas, where a number of radio and radar installations have been installed and operated successfully, believe that there is no insurmountable problem in constructing and maintaining relay stations at strategically located mountain sites in this region. The development and use of modern air-lift methods, including the use of helicopters as now regularly employed in Northern Canada and elsewhere, should be of substantial aid at points where access by other means

would be impracticable or would present serious difficulties.

Estimated Transmitter Power Requirement for Iceland-Faeroes Link

By utilization of the Bullington data as presented in his 1953 paper, it is possible to arrive at an estimate of transmitter power requirement for a wideband tropo-scatter circuit over the longest hop between islands in the North Atlantic on the route proposed in the NARCOM plan. This is the path between proposed relay sites in Iceland and the Faeroes, extending over a distance of approximately 290 statute miles, as shown in Fig. 5.

Referring to the Bullington data, in which are included median signal levels based on tests in the 300–4000-mc band over path lengths of 50 to about 400 miles, a median signal of 85 db below free space is indicated at a distance of 300 miles. Assuming a free-space propagation loss of approximately −143 db in the 800–1000-mc range at this distance, it is calculated that the total propagation loss between two isotropic antennas spaced 300 miles apart is about 228 db.

To offset this loss, a 50-kw transmitter providing a power level of +47 dbw, and two parabolic antennas having diameters of 60 ft, giving a combined gain of about 84 db at a carrier frequency in the 800–1000-mc range, will provide a total power level of about +131 dbw. The estimated input level at the receivers then will be approximately −97 dbw, excluding line and filter losses, which is considered to be well within the useful range of a UHF receiver for satisfactory operation with bandwidths of several megacycles.

To further offset propagation loss and to accommodate the system to the extremely deep fades that are experienced on long-range UHF or SHF circuits, antennas with larger diameters, quadruple-diversity receivers, and higher transmitter power may be provided. Also, by utilization of higher frequencies, such as those in the 3000–4000-mc band, parabolic antennas of given diameter are capable of developing a greater amount of effective radiated power. At relay sites of the transatlantic system, it is assumed that stations would be positioned at strategic elevated points, as high as practicable in order to provide maximum transmission effectiveness between adjacent stations of the relay chain.

Economic Considerations

Estimates indicate that the total construction cost of a transatlantic relay system for wideband services may be within the range of $35,000,000 to $50,000,000. While this is a substantial amount, it is not prohibitive when compared with costs involved in building the North American defense networks across Northern Canada, and is less than the cost of a modern ocean liner, such as the *United States*, which cost about $78,000,000.

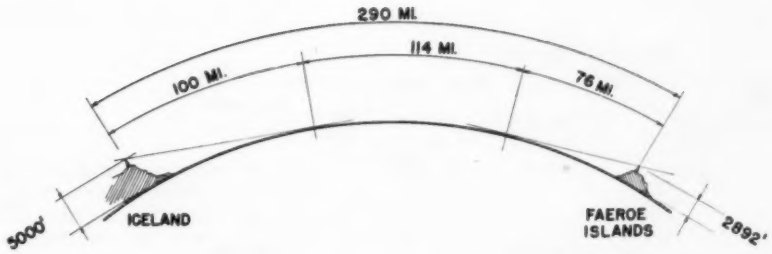

Fig. 5. Profile of "beyond the horizon" transmission path between Iceland and the Faeroe Islands, spaced approximately 290 miles apart, the longest over-water hop between continents in the North Atlantic area.

Apart from other considerations, there is a question of economics. Can such a system, desirable though it is, be justified on economic grounds and can it be operated to be self-supporting?

Almost certainly the several American television networks and some of the European broadcast organizations would become users of NARCOM. From past experience in televising important international occasions, such as the Coronation ceremonies in Great Britain and the Olympic contests, it can be assumed that for such events the American networks would be willing to pay the substantial charges required for transatlantic TV program services. It is probable, however, that TV or other broadcast activities would not constitute the basic source of revenue for the intercontinental relay system. The transcontinental microwave relay system across the United States is not primarily supported by the broadcast services. The mainstay for the existing American relay system is the large revenue derived from the telephone, teletype, and facsimile or wirephoto services, for which the demand outpaces the available facilities.

The rapid growth of international business and tourism, and the extensive development of international airways and shipping together with the availability of hundreds, and possibly thousands, of reliable voice circuits in wideband relay services between the two leading industrial areas of the world, would undoubtedly stimulate the routine use of telecommunication methods between the two continents by commercial and governmental organizations. As basic telecommunication traffic grows, it will provide the necessary economic foundation for successful operation of the system.

Revenue from the international broadcast services would be supplemental, although the services would contribute to the development of international understanding. Television viewers in the United States and Canada would certainly form a sympathetic audience for unusual progams from London or Vienna, while TV audiences in Europe would enjoy the unedited cross-section view of the United States and Canada presented by North American networks.

Problems of Conversion

The possibility of program exchange between nations in widely separated areas raises a question: the conversion from one standard, such as the 525-line, 60-field system of North America and most Latin American countries, to another, as the 625-line, 50-field system in use in the majority of Central European nations. Here, one practical solution of the problem appears to have been found in the scanning conversion methods used successfully over the past several years by the Eurovision network. A typical line-converter arrangement of the type employed in the European TV system is shown in Fig. 6. The initial network in which this system was first used is shown in Fig. 7.

Time Difference

A third question is concerned with the time difference between Europe and America. The solution to this problem appears to be in the use of new delayed-transmission techniques, based on utilization of wideband magnetic-recording devices, capable of storing both video and sound signals on magnetic tape. This process can be accomplished at master control stations located at strategic points on the two continents. Once recorded on videotape machines, the stored signals would be retransmitted at hours convenient for viewers in different regional zones.

International Agreements

A fourth question is: how can an international video project, which involves the necessity for cooperative agreements between a number of countries through whose territory the system would pass, be initiated and made a practical reality.

Consideration has been given to this question by Congress in Senate Joint Resolution 96, July 1954, which pro-

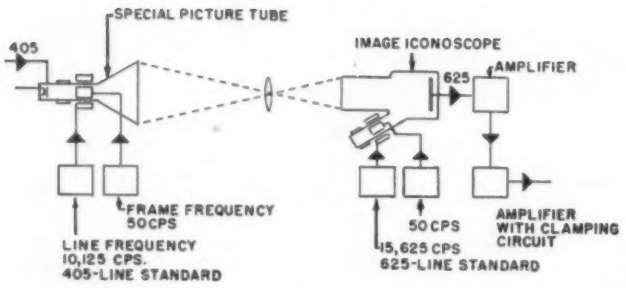

Fig. 6. Line converter employed in European Television Network.

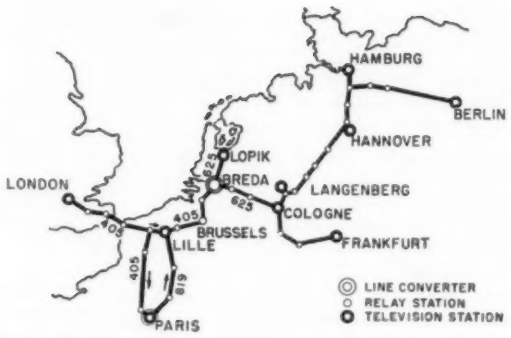

Fig. 7. International television relay system for coronation ceremonies.

posed the establishment of a Commission on International Telecommunications to make a study of global telecommunication, with emphasis on new transmission methods. The Commission's purpose would be to encourage the use of radio and television facilities in fostering international cooperation and understanding. A House Report, accompanying the resolution, stated that it was believed to be technically feasible to link the United States and the rest of the world by television and contained a reference to the NARCOM plan.

Although the Resolution passed both Houses of Congress and was signed by the President, funds were not approved, and the study has been postponed. It is expected that similar legislation will soon be introduced.

Substantial interest in transatlantic television has been expressed by leaders in American and European telecommunication organizations. Meade Brunet, Vice-President and Managing Director of RCA International, in commenting on the proposed transatlantic relay system, has stated:

"A radio-relay system of the type envisaged by the NARCOM plan appears to offer the first real advancement in method that has been proposed in many years. When it is realized that one good wideband circuit across the Atlantic could carry everything that is now transmitted in the 4 to 26 mc band, plus TV programs (on occasion), the economic aspects of such a circuit take on special significance."†

Systems Now in Existence

The most direct action leading toward the establishment in the near future of a wideband telecommunication relay system across the Atlantic will come, it is believed, as a necessary extension of the existing wideband relay facilities that link the numerous radar stations now operated by cooperating military services of the nations in the North Atlantic Treaty, or NATO, area. Here, the current use of coordinated radar systems for plotting and controlling the movements of military and civil aircraft over large international areas already has developed the need for wideband relay facilities for rapid communication and data exchange between radar stations and distant command points. These relay systems have, as a fundamental characteristic, a greater reliability of operation and communication speed than can be provided by the older forms of long-range radio signal transmission. In addition, the trend (in radar network operation) toward complete integration of multichannel communication and data-transmission facilities involves the use of bandwidths now approaching those required for video transmission techniques for certain air-defense and traffic-control operations.

While many of the wideband relay systems incorporated in the military networks are being constructed and operated under stringent security regulations, it can be assumed that basic steps have been taken in the direction of extending the North American wideband relay systems across the North Atlantic area. Agreements within the NATO framework already have permitted the installation of military relay systems of the wideband type in the European regional area which involve cooperation of the several member states, thus establishing a precedent for future networks.

Conclusion

The fact that wideband networks of the nations associated with NATO already exist, combined with the growing interest of nonmilitary organizations in the potentials of telecommunication by the new tropo-scatter methods, points to the emergence of a wideband transatlantic relay suitable for broadcast and general telecommunication services. It is believed that this will be an inevitable development in the present trend of international communication.

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† From Letter to the Editor, *Tele-Tech*, Oct. 1952.

Methods of Translating Used in Bilingual Films

By MAX G. KOSARIN

International TV broadcasting revolves around language translation. Methods of translating employed are dependent upon the degree of language conversion desired, subject to economic considerations. Methods described in this paper are: superimposed dialogue titles; off-screen narration; lip synchronization. The conversion of the dialogue is accomplished by the matching of the lip movements. This matching, or synchronization, begins with the foreign language writer, who is both translator and adaptor of the original dialogue. Basic speech sounds are the tools which make possible the flexibility of adaptation, which is limited by the number of syllables in a given phrase and the rhythm and emotional or dramatic delivery of that phrase.

THE CONCEPT OF broadcasting film on television, from one country to another and from one continent to another, takes in the engineering problems involved, including electronic and other technical aspects of communication systems, as well as the problems of programming. Telecasting a film from one nation to another, in which a different language is spoken, involves the nontechnical subject of language translation. Language is the vehicle of comprehension and appreciation of the original show, upon which the audience reaction will hinge.

The particular method of translation employed in a given instance will depend upon the degree of language conversion desired, which will be influenced to a great extent by economic consideration. That is, the budget allotted by the sponsoring agency will determine, pretty much, what type of foreign version will be produced. There is, of course, another factor to contend with in the selection of the type of foreign version, and that is the laws of the country with regard to the acceptability of a particular type of translation for exhibition there.

Methods of Translation

The methods of translation are: superimposing dialogue titles on the original film, either by optical or mechanical means; off-screen narration; and lip synchronization. Both superimposed titles and off-screen narration are relatively inexpensive means of conveying an understanding of a film, from one language to another. Superimposed titles, however, at best can convey only a small percentage of the actual dialogue spoken in the film. Furthermore, the reading of such titles on the television screen has presented a visual problem, due to the size of the screen in relation to the title, and the blocking of the title on both sides of the screen and at the bottom of the frame. This shortcoming, of course, can be eliminated by a realignment of the title. One laboratory, at least, is actually starting to do just that.

Off-screen narration, of course, is no problem for the commentary type of film. It becomes merely a question of the substitution of the soundtrack from one language to another. In dialogue films, the use of "intercalated," or inserted off-screen narration, has been limited mostly to Oriental audiences, who have long been accustomed to the commentator standing on the side of the screen, giving his interpretation of the story as it unfolds. This is what has been known in Japan as "benshi." In re-recording the track for the benshi version, selected sequences of the track are faded out and the commentator faded in with his narrative interpretation. Adapting this technique to motion pictures as a universal method has not as yet made great progress.

The technique of the actual recording of lip synchronization of dialogue from one language to another has been presented before this Society on various occasions.* The preparation of synchronizing loops, in the technique of foreign language recording, is also well known.

Definition of Lip Synchronization

The author defines foreign language lip synchronization as a device to communicate the dialogue of the original sound motion picture in the language to which the picture has been adapted by creating an illusion, simultaneously auditory and visual, that a previously photographed and recorded actor is speaking in the adapted language. To create the maximum illusion and to sustain it in the mind of the viewer, it is imperative not only that the synchronism of the spoken phrase be maintained, but also that the dramatic re-creation of the sequence be achieved.

Preparation of Script

It is not within the purview of this short presentation to take up, in any detail, the artistic aspects of rescoring, with possibly one or two exceptions. Confining the discussion to the translation of the script itself, lip synchronization can be prepared in two principal ways: The simplest and least costly, because of the relatively shorter time involved in its preparation, is the translation of a phrase or sequence to begin and end precisely at the same instant as the original voice so that the character on the screen will seem to be speaking the part, if not observed too closely. There is no attempt here to match every lip movement of the original dialogue. Only the length, or duration, of the phrase or sequence is matched.

True or complete conversion of dialogue is accomplished by translation employing phraseology and terminology that match exactly the lip movements, not of the words of the original dialogue, but the phrases and sequences of phrases, made up of the syllables in those words. This is the gist of the technique. The translator constructs his new dialogue to match visually, in the lip movement, the original spoken groups of words. Actually, he is thinking of syllables or groups of syllables, rather than the words themselves.

Employment of Speech Characteristics

The grammatical structure of languages varies so widely that any attempt to translate on the basis merely of similar words or similar juxtaposition of sentences or phrases, would make lip synchronization translation an impossibility.

The translator of dialogue, who might better be known as an adaptor, follows the science of speech sounds, called phonetics. He guides himself by certain known basic speech characteristics, under the general heading of *Pronunciation*. He knows that in the articulation of speech sounds, for example, certain sounds occur, known as explosive consonants, produced by puffs or impulses of breath.

Such sounds would be formed in uttering the letters p, b, t, d, k and g. A second group of sounds, called continuants, can be prolonged for a whole breath, without changing the position of the speech organs. These are: s, z, th, f, v, sh, zh, l, r, m, n and ng. All but l, m, n, ng and the trilled r, are known as frica-

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(This paper was received on November 21, 1957.)

* Max G. Kosarin, "Preparation of foreign-language versions of U.S. Army films," *Jour. SMPTE, 62:* 419–422, June 1954; and Mauro Zambuto, "Foreign language dubbing," *ibid., 63:* 222–224, Dec. 1954.

tives, characterized by a rustling made by a friction of the breath, by narrowing the aperture of the mouth. Vowels, except for slight variations, in many languages visually match in the articulation of the sound and the formation of the lips. It is the similarity, visually, of explosive sounds, such as b, p, t and d, and the similarity of certain fricatives, such as f and v, and the many possible combinations of explosive and fricative consonants, used in conjunction with the vowels, that give the translator a choice or flexibility in the composition of words and enable him to construct his dialogue in the correct grammatical phraseology of his language, yet at the same time match lip movement for lip movement, from one language to another.

In other words, in synchronization, by substitution, or interchange of words or phrases selected on the basis of the characteristics of speech sounds, the desired illusion is created. Coupled with the articulation of these basic speech sounds, in the construction of the translated dialogue there is the very important element of accent, or rhythm of language. This may be defined as the prominence given to a syllable or a word, which makes it stand out above adjacent syllables or words. It is this accenting, or rhythm, in the utterance of syllables, that makes up groups of words constituting the units of lip movements, which require faithful matching in the conversion from one language to another. These units are marked by pauses of speech utterance which the translator matches, utilizing the basic speech characteristics which have been described.

Matching of Script to Film

The translator actually begins his work by screening the film for general comprehension and appreciation of the story and its dramatic interpretation. He then receives the cued script of the original language with the synchronizing loop sequences marked off, as well as the pauses, or, as described before, the units of lip movements. He then does his first draft, employing the principles of phonetics but primarily writing for proper language and style. The final or adaptation phase is then done by viewing the film again, loop sequence by loop sequence. In this preparation for recording of the translated dialogue script, the translator, perhaps together with the director, reviews his work against the synchronizing loop, first by listening to the original soundtrack and then shutting off this original sound, and speaking the translated line against the sequence on the screen, which is now silent. He can now visualize and hear how the translated line will sound and what it will look like when combined.

Saying what a spoken line "looks like" is done deliberately. It is on this occasion that the translator will make his adjustments, by addition, deletion and substitution of words and phrases, to achieve better synchronization and naturalness of the line.

One reference should be made to the artistic aspect of lip synchronization and that is in connection with the casting of the actors. The careful casting of the dubbers, or voice actors, is very important as a factor in achieving perfection in lip synchronization. The voice actor should be cast as closely as possible to the original actor on the screen, with respect to voice quality, tempo of speech and perhaps even characteristics of facial expression which do affect the articulation of speech sounds. This care, or the lack of it, in the choice of the voice actor, to match the screen image in these respects, can spell the success or failure of the lip synchronization effort, regardless of a well-translated and well-matched dialogue. It is the interpretation and faithful following of the rhythm, emphasis and dramatic delivery of the line by the voice actor, in accordance with the synchronizing loop which he views and hears that will give the desired illusion, both auditory and visual, of the actor on the screen seemingly speaking in the new language.

It is obvious that the work of the translator, or adaptor, is a tedious, painstaking, detailed process, involving continued searching of memory and reference to experience for the appropriate phrase, idiom, or expression of language. Any modern aid, mechanical or electronic, that would assist the translator in accomplishing his research, might drastically cut the time required to prepare a lip synchronization recording script.

Mechanical Translation

There are repeated reports of machines that produce translations in many languages in a matter of minutes, such as the translating typewriter, many variations of the electronic data or digital computer, and others. It is the author's opinion, however, that we have not as yet reached that stage in our technological progress, where the machine can substitute for the human mind to the extent that it can produce the foreign language script for our lip-synchronized film version.

But, to indulge in a little projective thinking, it is conceivable that the electronic computer, for example, could be employed to store and provide an exhaustive amount of speech sounds, words and phrases, all predetermined in accordance with syllable structure and the other basic principles and characteristics of speech, across the board in a multitude of languages. This would be a combination thesaurus, dictionary, glossary, idiom and phrase reference source, which would place at the fingertips of the translator a wealth of material, instantly available, so as to permit him to devote most of his time to the actual creative and artistic task at hand.

At the close of the presentation of the above paper, the author presented several sequences of a film lip-synchronized from English to Spanish. This was done in collaboration with George Lewin, utilizing the recently developed technique involving the infrared transparency of magnetic tracks. An English language composite print, with optical track had been magnastriped full width and the Spanish soundtrack had been transferred to this magnastripe. First, the print was run with the magnetic Spanish track, demonstrating the lip synchronization. Then, the same sequence was rerun, picking up the original optical English track through the magnetic, full-width stripe.

Discussion

J. Kenneth Lewis (*Dept. of Defense, College Park, Md.*): Having in mind the description of Eurovision's six-language telecast and Mr. Kosarin's demonstration of converting from one language to another, we wonder if there would be enough time, say, in a six-hour delayed television program, to be able to do some sort of a reasonable job in making a language conversion for the audio?

Mr. Kosarin: It is hardly practical to compare translating with off-screen commentators who are just giving their running commentary in their particular language of a certain show.

Mr. Lewis: I was even thinking of cases where lip sync would be desirable.

Mr. Kosarin: You'd never be able to do that in a matter of a few hours, but you could do your running commentary in several hours.

Mr. Lewis: Would you be able to synchronize it to the point at least where you could get the phrases lined up, with the simpler (?) system which you described?

Mr. Kosarin: For a film like this that ran four or five reels the actual translation took about a week or so, and the actual recording took about four or five days of continued recording on the loops; and of course there was the time necessary to edit the picture. A good lip-sync effort of, let's say, a half hour to an hour, would certainly have to take several weeks.

Mr. Lewis: We could say when we arrive at the fully electronic translator that you were envisioning, this could be done very quickly.

Mr. Kosarin: Well, we could cut it down very appreciably; perhaps all around from, say, a four- or five-week job to a week or so.

George L. Beers (*Session Chairman*): I think some people have in mind a device which may do this sort of thing in a matter of minutes. Perhaps that's expecting too much.

A Case History of Bilingual Telecasting in Canada

By JACQUES LANDRY

This paper discusses methods of operation and special problems of TV broadcasting to French- and English-speaking audiences in Canada.

In Canada, bilingual telecasting is far beyond the wishing stage: it is a daily affair. In 1867, the Fathers of the Confederation decided that two languages would be official in Canada: English and French. Hence, the national broadcasting body, which is responsible to Parliament, simply has to operate accordingly.

Canada has a population of 16,500,000 people, of which 5,000,000 are French speaking, mainly in the Province of Quebec. At the beginning of TV — that is, 5 years ago — it was decided that the first stations in Montreal, Ottawa and Quebec City would carry programs both in English and French.

Initiation and Development

Let's consider the Montreal case, which was typical of one station that has to serve a two-language audience. Since French Canadians account for some 70% of the population in the area, the rule was: two-thirds of the programs in French and one-third in English. That looked like a fair deal. But not to the viewers!

French Canadians as a group are sensitive about the language question and anxious to preserve their native tongue. They felt that regular English programs presented on "their" channel was an intrusion into their homes. Their reaction became more violent when the proportion of English on the daily menu jumped to 50%. This of course was due to the availability of many Toronto and New York programs and the difficulty, at that pioneering period, of producing a great number of programs in the French language.

On the other hand, the English part of the audience, even with this relatively generous 50–50 treatment, did not quite understand why they could not have a full schedule in their own language. Numerous demands were coming from both sides, and the CBC soon announced the opening of a second station in Montreal, all English. The original one was to be converted to French. The same story could be told of Ottawa and Quebec City, where bilingualism is now taken care of by two separate stations.

The initial system of one bilingual station, however, pleased some discriminating people. When the second station was announced in Montreal, Dr. Cyril James, Principal of McGill University, stated sadly: "This is the worst thing that could happen. We were starting to learn French!"

There still remain some bilingual stations in Canada: three in English and three in French areas. "Bilingual" is being used here for any amount of programs in the other language: in some instances, this is not more than two hours a week, and in others it goes up to 25% of air time.

There are today 42 TV stations in Canada, of which 36 are primarily English and 6 primarily French. An engineer will appreciate what this represents — the setting up of two separate networks, in a country as wide as the U.S.A., for a population ten times smaller. And still the United States has only three networks. The rate of TV expansion in Canada has been the fastest anywhere. Eighty-six per cent of the population is covered today, and this was achieved within five years.

Network Problems

As far as programs are concerned, bilingual telecasting creates two sets of problems, instead of one. Both networks wish to retain a Canadian identity, by producing original shows. But while the English network can tap the immense reservoir of American programs to supplement its own production, the French network has not much of a choice and is practically compelled to produce its own fare of genuine TV shows. The result is as follows: on the English side, 63% of the programs are Canadian-produced, and 37% are U.S.A., with other English sources supplying less than 1%. (You will note that the U.S. portion is selected among the best of the *three* sources: NBC, CBS, ABC.)

On the French side, there is no big supplier in the neighborhood: CBC studios produce up to 80% of the French network output, films from France accounting largely for the remainder. Since CBC-TV operates from midafternoon to midnight, it will be no surprise for you to learn that Montreal now stands first in the world among TV centers of French language, and that Montreal and Toronto are second only to New York and Hollywood as far as live TV production is concerned.

These two networks, actively operating, are a permanent demonstration of bilingual telecasting in one country. At times, the same programs are being fed to both networks. For the third summer, this was done in the case of the half-hour show, *Serenade for Strings*. The technique is quite simple: the host is bilingual and makes his announcements first in English and then in French, or the reverse. The songs are selected from both language repertoires. In this way the whole country is subjected to bilingualism. Another series similarly broadcast is *The Concert Hour*. Its new season debut, in September, was a two-hour live production of Gounod's opera *Faust*, sung in French. A special musical program, a *Salute to Queen Elizabeth*, originated partly in English from Toronto and partly in French from Montreal, with a bilingual hostess.

Reaction to Bilingual Operation

As a whole, the Canadian public seems to go for this type of bilingual operation. Of course, there are a number of viewers who oppose any use of the other language on their sets. Once we did Puccini's *La Bohème* on *Concert Hour*, in the original Italian version. The CBC received complaints from English viewers who protested against "all that French singing" and from French viewers who urged us to "stop presenting those English programs"... That shows you how bilingual you can get!

Other big operations are conducted jointly by the two networks. For instance, Canada's General Elections, last June, were fully covered in both languages. CBC's pickup facilities at six major points throughout the country were used on an alternate basis, according to a preset schedule. Later in the evening the former Prime Minister, in Quebec City, and the newly elected Mr. Diefenbaker, in Regina, both addressed the Nation bilingually on a simulcast basis.

Program Planning

Another formula, used for a weekly half-hour drama series called *The Plouffe Family*, consists of broadcasting live the French version on Wednesday night and the English version, live also, on Friday night. This has been going on success-

Presented on October 8, 1957, at the Society's Convention at Philadelphia by Jacques Landry, CBC-TV French Network, P.O. Box 6000, Montreal.
(This paper was received on October 9, 1957.)

fully for three years with the same script, same cast, same producer, same technical crew. The program has the top rating in French and is among the top 10 in English. One interesting aspect of this is that the French show attracts 9% of the English audience, and the English show 20% of the French audience. This is not the only case of looking at the other network. The French audience likes *Hitchcock*, *Studio One*, *Disneyland* and *Perry Como*, while the English audience likes *La Lutte* (that is, *Wrestling*, live) and a rural drama series, *Le Survenant* (translation, which has been published here, *The Outlander*). This habit of watching the opposite show may go too far, at least in the opinion of the Program Directors. In the Montreal area, *Toast of the Town* was winning the majority of TV homes. The French network decided to schedule, Sunday night at 8:00, its big variety show of the week. We feel sorry for Sullivan, but he lost out.

The program planning methods used for bilingual live shows apply also to TV films. One bilingual film product of the CBC is a 26-episode adventure series of the early Canadian explorer *Radisson*. The export version is called *Tomahawk*, and, to suit the taste in the United States, it has no cliff-hangers. Each episode was filmed first in French and then in English, with the same bilingual actors, same director/producer, same crew. At least one series of documentary type, *Here and There*, dealing with various aspects of life in Canada, is produced for the two language groups. The basic scripts are the same, but the occasional interview is filmed in one language and then in the other.

Dubbing Operation

This leads us into the question of film dubbing, which is more frequent than the completely bilingual production. We do some of it locally. One example is the official French version of *Victory at Sea*, which is in the making in Montreal according to an agreement between NBC and CBC. Our experience is that documentaries are the type of films that lend themselves the most easily to translation. The big difficulties encountered are in drama films. It is not so much a question of technique — thanks to the engineers and to the translation experts. It is, broadly, a question of culture: will a certain series written in one language be suitable in another? Will it retain its flavor, its meaning, its value? I have in mind an American western TV film that was dubbed in Paris in Parisian French: it would be laughed at in the Province of Quebec, because it sounded so unbelievable. The attitude in these cases has to be a highly selective one, based on the knowledge of the people for whom the dubbing is intended.

Conclusion

International television is already being practiced to some extent, and mention should be made of Canada's present part in it. The CBC exchanges programs with U.S. networks even if the trade balance is heavy in favor of the U.S.A. An interesting point is Canada's international cooperation in some live shows. The *Wide Wide World* program on the St. Lawrence Seaway contained a large Canadian portion requiring 19 cameras. During Queen Elizabeth's Tour in Canada and the United States, live programs were exchanged between the two countries. Certain TV programs are also circulated between Canada, England and Australia. One of the biggest cooperative efforts is the *Children's International Newsreel*, inspired by Eurovision. For this program, Canada exchanges bimonthly items with 14 countries. CBC-French also has imports from RTF (France), Télé-Luxembourg and Télé-Monte-Carlo. These are produced in cooperation with the CBC.

Bilingual telecasting in Canada has been highly successful. Let us hope that the same will be true of international television. It can be a splendid instrument to bring closer together nations and men everywhere.

Future Trends in Multi-Voice Films for International Television

By LEON SHELLY

The world availability of magnetic sound equipped projectors in TV stations opens up new markets for internationally minded producers. The tools are presently available for producing bilingual films for this market. These tools and the preplanning necessary to make such films most effective are here presented.

THE purpose of this paper is to look at the international television field through the eyes of a commercial film producer.

It seems crystal clear from the preceding papers that international television has created a market for multi-voice films throughout the world and that the tools and techniques are now available to the commercial producer to meet the demands of this market.

In looking at this new field, there are two basic questions which a commercial film producer will ask: (a) what tools and techniques will be available to him, and (b) what new problems must he consider in entering this field.

The tools required for multi-voice films are based on recent developments in the magnetic field presented to Conventions of the Society and published in the *Journal*. Briefly, they can be summarized as follows:

(1) Single-system magnetic camera, such as the Auricon.

(2) Sync Shifter by Ellis W. D'Arcy, to move the single-system magnetic track to editorial position and then back to normal position after cutting the negative.

(3) Magnetic striping of all types of 16mm film either before or after developing.

(4) Magnetic printing.

(5) Projection equipment in television stations which will reproduce magnetic track on 16mm films.

(6) Postsynchronization service by studios.

The paper by Kosarin, earlier in this issue of the *Journal*, ably outlines the techniques involved in producing multi-voice films from a standpoint of translation and postsynchronizing. The film presented by Kosarin with the cooperation of George Lewin proves the practicability of postsynchronizing a second language of lip-sync scenes and projecting the two languages simultaneously, in synchronism from one 16mm print. In this connection, it should be mentioned that Lewin's development of infrared transparency of magnetic tracks opens up interesting new horizons for commercial producers. For example: this development coupled with Halstead's Multiplex System will make it possible to telecast two languages simultaneously from 16mm film in bilingual countries such as Canada. There are members of our Society who believe that Lewin's development will make it possible to place four tracks with four language versions on one 16mm print.

This paper was presented on October 8, 1957 at the Society's Convention at Philadelphia by Leon Shelly, Shelly Films Ltd., Toronto 14, Ont., Canada.
(This paper was received on December 31, 1957.)

Basic Problems

In looking at the new problems facing a film producer entering this field we must place at the top of the list the fact that he must condition all his thinking to the international scene. In other words, in addition to being a film producer, he must now learn to be an international diplomat. He must realize that he is entering a large area of compromise and, as in the field of diplomacy, he must learn to compromise while there is still time to do so.

Since one of the major objectives of a good commercial producer is to obtain a high degree of acceptance of his film in the markets in which it will be shown, it would seem advisable for the producer to send the original story to the foreign countries involved for checking before writing the scenario. A story which is acceptable in the United States or Canada might even be offensive in another country.

By the same token, the scenario should also be checked in the foreign countries involved before shooting the original version. For example, idioms and colloquialisms should be used in the original scenario only if they mean the same thing in the subsequent foreign versions. A symbol in one country might mean an entirely different thing in another country. The dove is a symbol of peace to us, whereas in China it is a symbol of death.

All scenarios should be checked against the laws of the countries involved. Some countries even have laws protecting the purity of their language, and scenarios must be considered in the light of these laws.

Special Procedures

If narration is to be used in the film, adequate footage should be allowed in each sequence so that the translators and narrators of the foreign versions can complete their work within the footage limits of each sequence.

In sequences involving lip-sync, the translators of the foreign versions should be given an opportunity to make suggestions for dialogue of the original version before shooting.

At the time of shooting the original scenario, the Director should be conscious of the problems involved in producing subsequent foreign versions of the film. If it is possible to have the Director for the post-synchronizing on the set with the Director of the original version, it will insure optimum results in subsequent foreign versions. For example, close-ups of dialogue should only be shot on scenes where it will be relatively easy to do post-syncing of the foreign versions.

In sequences where it will be difficult to do the post-syncing of foreign versions, the sequences in the original version should be filmed as long shots or with the faces at an angle to the camera which will make it difficult for the audience to follow the movement of the lips.

Actions of the cast must be carefully supervised by the Director, because a certain action which might be funny on this continent, could be offensive in another country.

Inserts required for the foreign versions should be shot at the time of shooting the original version and the negative of these inserts put in the vault until the foreign versions are made.

The above are examples of the continual battle of compromise facing the film producer if he is to achieve his objective of a high degree of acceptance of the film in the various foreign countries. While this undoubtedly presents the film producer with a new set of problems in addition to the problems he is already familiar with, multi-voice films in international television open up a new exciting field with an unlimited horizon. The feeling of accomplishment in playing a part in better world understanding and world peace will more than offset the additional problems involved.

Averaging Screen-Illumination Readings

By ARMIN J. HILL

In obtaining the total output of a projector, or the total illumination which falls on a projection screen, it is customary to read the incident intensity at selected points in the illuminated area. These readings are then averaged by a suitable weighting formula to give the average over the face of the screen. This paper discusses some of the more commonly used formulas, considers their relative accuracy and the effects of various screen aspect ratios on the results obtained with them. It also analyzes various types of errors on the basis of an idealized distribution pattern which experience has shown checks closely with practical results.

THE TOTAL luminous flux which falls on a projection screen is commonly measured by reading the incident illumination at selected points on the surface of the screen or in a reading plane between the screen and projector. A suitable average of these readings is then multiplied by the area illuminated in the reading plane to give the total luminous flux incident on the screen.

Because of the variation in illumination from point to point, a strictly accurate value could be obtained only by using a meter having a very small "paddle" and by taking readings at each point in the reading plane. Fortunately from a practical standpoint, the variation is such that a reasonably accurate result can be obtained by taking readings at a comparatively few reading points, and then averaging these in some suitable manner which "weights" each reading according to its relative importance.

The averaging process can best be visualized by imagining that from each point of the reading plane a line extends, perpendicular to the plane and with a length proportional to the illumination at that point. These lines will fill a solid, having the reading plane as its base, planes along the edges of the illuminated area and perpendicular to the reading plane as its sides, and a curved surface representative of the variation in incident illumination as its sixth boundary. In general, this surface will be convex toward the projector since the illumination at the center will generally exceed that at the edges and corners.

The volume of this solid will represent the total incident luminous flux, and the average "depth" will represent the average incident illumination. Our problem is to determine a suitable average depth from a relatively few selected readings. An effective method of doing this for solids of this type is given by Simpson's approximation.* This is applied by first dividing the solid into an even number of uniformly thick sections by means of planes each of which is perpendicular to the base and parallel to one pair of the sides. One of these planes will probably have a form similar to that shown in Fig. 1.

If we assume that there are $2n$ such sections, each of uniform thickness H, and if we let the areas of the end planes and successive sectional planes be represented by A_0, A_1, $\ldots A_{2n-1}$, A_{2n}, then according to Simpson's approximation, the volume V of the solid will be given by:

$$V = \frac{H}{3}[(A_0 + A_{2n}) + 4(A_1 + A_3 + \cdots + A_{2n-1}) + 2(A_2 + A_4 + \cdots + A_{2n-2})] \quad (1)$$

In a similar manner, we can divide each section into an even number, $2m$, strips having uniform width, h, by lines whose lengths can be represented by y_k. An approximation of the area, A_j, will then be given by:

$$A_j = \frac{h}{3}[(y_{j0} + y_{j,2m}) + 4(y_{j1} + y_{j3} + \cdots + y_{j,2m-1}) + 2(y_{j2} + y_{j4} + \cdots + y_{j,2m-2})] \quad (2)$$

The Nine-Point Method

If readings are taken at the center of the reading plane, at each of the four corners, and at mid-points along each of the sides of the illuminated area, a total of nine readings will be taken. Simpson's approximation can be applied by dividing the area first into horizontal (or vertical) sections, and then dividing each sectional plane into strips as just outlined. Letting a represent the width of the area, and b its height (and assuming that the first divisions are horizontal — they can be taken either way), then $H = a/2$, $n = 1$, $h = b/2$, and $m = 1$. We then have from Eq. (1):

$$V = \frac{a}{6}[(A_0 + A_2) + 4A_1)] \quad (3)$$

and from Eq. (2):

$$A_0 = \frac{b}{6}[(y_{00} + y_{02}) + 4y_{01}]$$
$$A_1 = \frac{b}{6}[(y_{10} + y_{12}) + 4y_{11}] \quad (4)$$
$$A_2 = \frac{b}{6}[(y_{20} + y_{22}) + 4y_{21}]$$

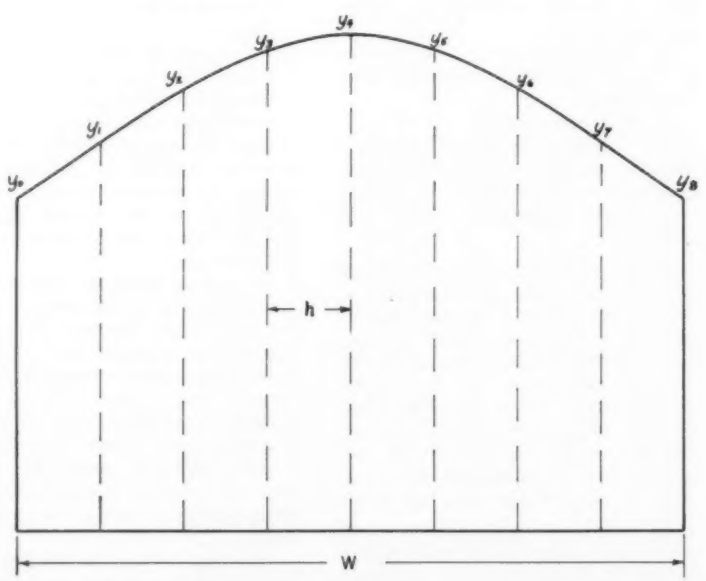

Fig. 1. Section of a solid as used with Simpson's approximation. Here $m = 4$ or $h = W/8$. The area of such a section would be given by:

$$A = h/3[(y_0 + y_8) + 4(y_1 + y_3 + y_5 + y_7) + 2(y_2 + y_4 + y_6)]$$

* Simpson's approximation or "rule" is treated in most texts on integral calculus. See, for example, *Advanced Calculus* by Frederick S. Woods, Ginn and Company, Boston, 1934, p. 139.

Presented on October 5, 1957, at the Society's Convention at Philadelphia by Petro Vlahos (Motion Picture Research Council, 6660 Santa Monica Blvd., Los Angeles 38) for the author, formerly of the Motion Picture Research Council and now: Dean, College of Physical and Engineering Sciences, Brigham Young University, Provo, Utah.
(This paper was received on September 5, 1957.)

where the points represented by the subscripts are as indicated in Fig. 2. Substituting the values of Eq. (4) in (3), and remembering that the area of the base is ab, we can write the expression for the average incident illumination, E_{avg}, as:

$E_{avg} = \frac{1}{36}$ (sum of 4 corners + 4 × sum of mid-points + 16 × center) (5)

This formula is valid only when the readings are taken at the extreme corners and at mid-points along the very edges of the illuminated area. Unless the measured area is a centered portion of a larger illuminated area (such as would be obtained by removing the projector aperture), vignetting effects make these extreme edge and corner readings quite unreliable. It has therefore become customary to take them in a short distance as shown by the small circles in Fig. 2. The distance these are taken in from the edge is usually expressed as a percentage of the corresponding screen dimension. This can be represented by s, although mathematically it is easier to work with the ratio indicated as p, in Fig. 2, which is the proportion of the distance to the reading point from the center as related to the total distance from the center to edge or corner. It is seen that these two ratios are related by the expression:

$$s = (1 - p)/2 \qquad (6)$$

Customarily s is taken as 5% or $\frac{1}{20}$ of the corresponding screen dimension. When this is done, a better average value than is obtained from Eq. (5) is given by:

$E_{avg} = \frac{1}{24}$ (sum of 4 corners + 3 × sum of mid-points + 8 × center) (7)

as shown in the Appendix.

These expressions indicate the importance of taking accurate center readings. In fact, for the best results, each of the readings should be taken a number of times in proportion to the weighting factor appearing in the appropriate formula. For example, if nine reading points are used with $s = 5\%$, and Eq. (7) is applied. a correctly weighted accuracy of the various readings will be obtained if the center reading is taken eight times, and each of the mid-points taken three times, for each time the corner readings are taken. Conversely, an error in the center reading will be relatively several times more serious than a corresponding error in mid-point or corner readings.

The Five-Point Method

This method uses measurements made at the points (1), (4), (5), (6) and (9) as shown in Fig. 2 and as described by Kolb.† For square or practically square areas very close results will be obtained by again taking $s = 5\%$. This method is somewhat faster than the nine-point method, and gives more consideration to the corner readings than does the three-point method. As is shown later, it is somewhat better than the three-point method in case the illumination pattern is not accurately centered. In both this and the three-point method, the illumination pattern should be carefully balanced and centered before the readings are taken. The average is obtained by using:

$E_{avg} = \frac{1}{10}$ (sum of 2 corners + 2 × sum of sides + 4 × center) (8)

or as sometimes given:

$(\frac{1}{8})$ (avg of 2 corners + sum of sides + 2 × center)

In case the screen is not nearly square, an error will be introduced which will increase with aspect ratio, i.e. with the ratio of picture width to height. This, incidentally, is not true of the nine-point method. A suitable correction can be made for this error by increasing the value of s with increase of aspect ratio as shown in Table I.

† F. J. Kolb, Jr., "Specifying and measuring the brightness of motion-picture screens," *Jour. SMPTE, 61:* 552, Oct. 1953.

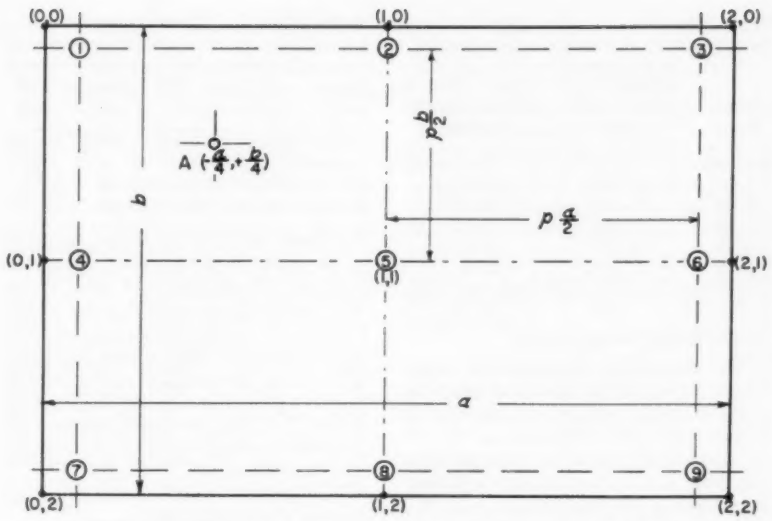

Fig. 2. Measuring positions in reading plane. Extreme corners and mid-points are shown as solid dots and are identified by numbers in parentheses. Measuring points are usually taken in a short distance to avoid errors due to edge vignetting. These positions (for $s = 5\%$) are shown by the numbered circles.

Table I.

Aspect ratio	Prop. distance of reading pt. from center lines	Prop. distance in from edge or corner
$r = a/b$	p	$s = (1 - p)/2$
1.00	0.914	4.30%
1.33	0.855	7.03
1.80	0.811	9.45
2.35	0.787	10.65
2.55	0.782	10.90

As an example, if Eq. (8) is to be applied correctly for an aspect ratio of 2.35, the readings should be taken in 10.65% of the corresponding screen dimension (width *or* height), rather than the $\frac{1}{20}$ or 5% usually recommended. For a screen 35 ft wide (by 15 ft high), this would mean that the side readings would be in 3 ft $8\frac{3}{4}$ in. and the corner readings would be in from the top and bottom edges a distance of 1 ft $7\frac{1}{4}$ in. The accuracy with which these reading points need to be located, is discussed in a later section.

The Three-Point Method

When the illumination pattern is well balanced and centered, readings of the center and two side positions can be taken and averaged and the result will be in close agreement with those obtained by the more complex methods. The formula to be applied is simply:

$E_{avg} = \frac{1}{3}$ (sum of two sides and center) (9)

In fact, although the errors due to positioning of the reading points or centering of the pattern are more serious than when more readings are taken, this method gives the most information for the amount of time or effort expended of any, and should be used when economy of time is an important factor.

This method will give correct results for a square screen when the "side" readings are taken exactly at the edge. For other aspect ratios, the proportional distance in from the edge at which the readings should be taken to give best results are shown in Table II.

Table II.

Aspect ratio	Prop. distance of reading pt. from center line	Prop. distance in from edge or corner
$r = a/b$	p	$s = (1 - p)/2$
1.00	1.000	0.00%
1.33	0.885	5.75
1.80	0.809	9.55
2.35	0.768	11.6
2.55	0.760	12.0

Errors From Various Causes

The Simpson's approximation upon which the foregoing discussion has been based is exactly correct when the curved surface of the "illumination solid" is one which would be generated by revolving a conic section about its own axis, having this axis coincide with the axis of symmetry of the solid, i.e. the line through the center of the base and perpendicular to it. Tables I and II are calculated on the assumption that the curved surface is a paraboloid of revolution about this central axis.

Experience has shown that most distribution patterns match this type of distribution quite closely, and that particularly the nine-point method will give a very close approximation to the correct value. Using this assumption of a paraboloidal distribution, it becomes possible to discuss the errors which may be introduced by such factors as incorrect positioning of the meter paddle, by not giving correct allowance for the aspect ratio, and by failure to center the distribution pattern exactly in the projected picture area. The values given here are based upon a paraboloidal distribution and therefore will not hold exactly for other types. However, they show the order of magnitude of the errors which can be expected under fairly normal conditions, and also can be used to compare one method of measurement with another. The equations used in these calculations are derived and discussed in the Appendix.

A. Errors introduced by taking all readings with $s = 5\%$ without regard to aspect ratio. Tables I and II indicate the values of s which will give theoretically correct readings (for paraboloidal distributions) for various aspect ratios. Customarily, however, the readings are taken at the mid-points and corners by placing the meter paddle in about $\frac{1}{20}$ of the corresponding screen dimension, in other words by using $s = 5\%$. As shown in the Appendix, this will give practically correct readings for all aspect ratios when the nine-point method is used and Eq. (7) is applied. However, for the five-point and three-point methods, the errors shown in Table III will result. In all instances the resultant averages will be smaller than the correct values.

Table III.

Aspect ratio	Side-center ratio = 0.60		Side-center ratio = 0.80	
	5-pt.	3-pt.	5-pt.	3-pt.
1.33	3.74%	1.28%	1.59%	0.54%
1.80	6.27	6.52	2.76	2.87
2.35	7.46	8.96	3.34	3.99

B. Errors introduced by careless positioning of the paddle in taking center reading. To indicate the magnitude of these errors, the assumption is made that the paddle is off-center by an amount equal to 10% of the distance from center to corner (5% of the diagonal). It seldom will be accidentally placed much farther from center than this. Resultant averages will be below correct values by the amounts shown in Table IV.

It is seen that errors from this source will probably be negligible.

C. Errors introduced by careless positioning of the paddle in taking side and corner readings. Here an error in the position of the paddle of $\frac{1}{10}$ of the distance from the reading point to the nearest edge of the picture area is assumed. While a paddle may quite easily be out of position by this amount, it probably will not be by more than twice this value. Since errors may be either plus or minus depending upon the direction in which the positioning is in error, they will probably tend to cancel out rather than to accumulate. Errors shown in Table V are computed on the assumption that the same positioning error is made in each mid-point or corner reading, and in such a direction that all errors are maximum and cumulative.

We can conclude that errors due to mis-positioning of the paddle, if ordinary caution is exercised, will probably always be of the order of 1 or 2% or less.

D. Errors introduced by not having distribution pattern centered in picture area. The order of magnitude of the errors caused by not having the distribution pattern carefully centered is shown by assuming that maximum illumination is in the center of one quadrant of the screen, i.e. at one of the four points indicated by the coordinates $(\pm a/4, \pm b/4)$. The pattern is still assumed to be paraboloidal, although the shape of the generating parabola will not be quite the same for a given side-center ratio as for the other calculations. This is because the side values are now different and the average of the two is used for calculating this ratio.

Interestingly, the nine-point method using Eq. (5) will give correct results even under these adverse conditions — providing that good readings can be obtained at the extreme sides and corners. The modified nine-point method, reading with $s = 5\%$ and using Eq. (7), will give results that are slightly high as shown in Table VI. The other two methods give results that are too large for the smaller aspect ratios, but too small for the larger aspect ratios. In other words, for one intermediate aspect ratio the results will not be in error at all. Generally these errors are more serious for the three-point method than for the five-point method, as would be expected.

Another interesting fact is that with the five-point method the same results are obtained whether the center of the pattern is in a quadrant having a corner reading point, or is in one of the opposite quadrants.

In calculating the nine-point results, reading positions are assumed to be at $s = 5\%$. For the other methods, readings are assumed to be taken with the values of s given in Tables I and II.

Table IV.

Aspect ratio	Side-center ratio = 0.60			Side-center ratio = 0.80		
	9-pt.	5-pt.	3-pt.	9-pt.	5-pt.	3-pt.
4/3	0.34%	0.41%	0.35%	0.15%	0.18%	0.14%
1.80	0.28	0.33	0.28	0.12	0.14	0.12
2.35	0.24	0.29	0.24	0.11	0.13	0.11

Table V.

Aspect ratio	Side-center ratio = 0.60			Side-center ratio = 0.80		
	9-pt.	5-pt.	3-pt.	9-pt.	5-pt.	3-pt.
1.33	0.78%	0.87%	0.82%	0.34%	0.38%	0.35%
1.80	0.62	0.75	0.76	0.27	0.33	0.33
2.35	0.54	0.70	0.74	0.22	0.32	0.33

Table VI.

Aspect ratio	Side-center ratio = 0.60			Side-center ratio = 0.80		
	9-pt.	5-pt.	3-pt.	9-pt.	5-pt.	3-pt.
4/3	+4.74%	+1.49%	+4.09%	+1.96%	+0.59%	+1.67%
1.800	+3.71	−3.42	−3.83	+1.60	−1.37	−1.53
2.35	+3.25	−6.30	−9.38	+1.42	−2.53	−3.70

Comparisons of the Various Methods

A set of actual screen-illumination readings‡ was used to compare the three methods which have just been discussed. These were taken on two projection machines, and by the five-point method. A special curve-fitting formula was used to compute probable values at the extreme edges and corners, and to supply the missing readings for the nine-point method. From these a "true" average value was computed which is probably better than one obtained by any of the averaging equations discussed here. Average values were then computed using each of the formulas discussed in this article and the results are shown in Table VII.

Table VII. Analysis of Examples From Informational Bulletin #6. Screen Dimensions: 21 ft × 15 ft 4 in.; Aspect Ratio — 1.37. All Values Are in Foot-candles.

Given Readings:	Projector 1	Projector 2
Center	14	17
Sides	11–13	14–15
Corners	10–10	13–14
Computed Readings:		
Mid-points top and bottom	13.24	15.58
Extreme side (avg)	11.20	14.05
Extreme top and bottom (avg)	12.96	15.38
Extreme corners (avg)	8.29	12.85
Computed Average Illumination:		
"True" average	12.50	15.52
9-pt. formula (Eq. 5)	12.51	15.51
9-pt. formula (Eq. 7)	12.64	15.30
5-pt. formula (Eq. 8)	12.40	15.30
5-pt. formula (corrected*)	12.64	15.47
3-pt. formula (Eq. 9)	12.70	15.35
3-pt. formula (corrected*)	12.74	15.43

* Corrected for aspect ratio. With this low an aspect ratio, it is seen that these corrections are not significant.

It is seen that in no case does the error in the average value exceed 2%. This is well within the probable error of the original readings.

Conclusions

We can conclude that when the illumination pattern is symmetrical and well centered, and when the aspect ratio is less than about 1.50, any of the described methods will give satisfactory results with readings taken in $\frac{1}{20}$ of the corresponding screen dimension from the edges or corners ($s = 5\%$). With larger aspect ratios, either the reading positions can be changed or small corrections can be applied to give acceptable averages.

‡ These values are taken from the samples given in *Informational Bulletin No. 6*, Motion Picture Research Council.

If ordinary caution is exercised in positioning the paddle of the reading meter, errors due to incorrect positioning will probably be negligible. Errors caused by an unsymmetrical pattern, or by not having the pattern centered on the screen can be significant, particularly with low side-center distribution ratios. Again, however, only ordinary caution need be exercised to keep these within reasonable limits.

Maximum information for the effort expended is given by the three-point method. For comprehensive analysis and the most accurate results, the nine-point method should be used. The five-point method gives a check on the corner readings, but is nearly as time-consuming as the nine-point method, and may be thrown into more serious error by an unbalanced illumination pattern.

APPENDIX

Simpson's approximation gives exact results for solids of the type discussed in this paper when the surface is generated by rotating a conic section about its axis, keeping this axis perpendicular to the base of the solid. To examine the relative accuracy of the various methods, and analyze the errors due to various factors, the assumption is made that the generating curve is a parabola. In general, the assumption is also made that the axis of rotation passes through the center of the base of the solid (i.e. the center of the picture area).

Let the curved surface of this paraboloid of revolution be represented by the equation:

$$c - z = k(x^2 + y^2) \qquad (1a)$$

with the base of the solid formed by the plane $z = 0$, and the sides formed by the planes $x = \pm a/2$, and $y = \pm b/2$. Obviously c represents the center reading. The volume of this solid can be obtained by integrating $z dy dx$ over the area of the base:

$$V = 4\int_0^{a/2}\int_0^{b/2}[c - k(x^2 + y^2)]dydx = abc - \tfrac{1}{12}abk(a^2 + b^2) \qquad (2a)$$

Letting $d = \frac{k}{4}(a^2 + b^2)$, this reduces to:

$$V = ab\left(c - \frac{1}{3}d\right) \qquad (3a)$$

or the average value of z is given by:

$$E_{avg} = c - d/3 \qquad (4a)$$

Now at the corners $z_{d0} = c - d$, and the sum of the four mid-point readings taken at the extreme edges of the picture area (assuming no vignetting effects) will be $2(c - ka^2/4) + 2(c - kb^2/4) = 4c - 2d$, which when substituted in Eq. (5) gives:

$$E_{avg} = \tfrac{1}{36}(4c - 4d + 16c - 8d + 16c) = c - d/3 \qquad (5a)$$

in exact agreement with (4a) as obtained by integration. Notice that this result is independent of the aspect ratio a/b.

Approximation When Readings Are Not Taken at Extreme Edges

Because of trouble with edge vignetting, readings are usually taken slightly in from edges and corners. Considering that these reading points are along the lines $x = \pm pa/2$, and $y = \pm pb/2$, where p is a proportionality constant less than unity, we find that the corner readings become:

$$z_d = c - p^2 d \qquad (6a)$$

the side mid-point readings,

$$z_s = c - kp^2a^2/4 \qquad (7a)$$

and the top and bottom mid-points have readings of:

$$z_t = c - kp^2b^2/4 \qquad (8a)$$

If these are averaged using Eq. (5), we have the result:

$$E_{avg} = c - p^2 d/3 \qquad (9a)$$

For values of p other than unity, this will no longer give the correct average, but will be large by the amount $(1 - p^2)d/3$. When $p = 0.90$, ($s = 5\%$), this error becomes $0.19d/3$ or $0.063d$, which for small side-center distribution ratios is not large. For example, with a side-center ratio, z_s/z_c, of 0.60, this will be less than 3%. However, it can easily be avoided by using another averaging equation which for $p = 0.90$, gives very accurate results. This equation is given as (7), and when applied to the above values it gives:

$$E_{avg} = \tfrac{1}{24}(4c - 4p^2d + 12c - 6p^2d + 8c) = c - \tfrac{10}{24}p^2d \qquad (10a)$$

This will give a correct result for a paraboloidal distribution when $\frac{10}{24}p^2 = 1/3$ or when $p^2 = 0.80$, i.e. when $p = 0.8944$. The error when $p = 0.90$ is thus seen to be negligible (less than 0.1% for a side-center distribution of 0.60).

Exact Formulation of Five-Point Approximation for Paraboloidal Distribution:

Let the aspect ratio $a/b = r$, and let $g = (1 + r^2)/2r^2$. We find then that $ka^2/4 = d/2g$, so that the values of the side readings can be represented by:

$$z_s = c - p^2 d/2g \qquad (11a)$$

with the corner readings again being given by Eq. (6a). The five-point approximation (8) then gives:

$$E_{avg} = 0.1(2c - 2p^2d + 4c - 2p^2d/g + 4c) = c - 0.2p^2d(1 + 1/g) \qquad (12a)$$

This will give exact results for a paraboloidal distribution when:

$$p^2 = \frac{5g}{3(1 + g)} \qquad (13a)$$

Table I is calculated from this equation.

Exact Formulation of Three-Point Approximation for Paraboloidal Distribution

Using z_s from (11a) with the center value c and applying Eq. (9) we have:

$$E_{avg} = \frac{1}{3}(2c - p^2d/g + c) =$$

$$c - \frac{p^2d}{3g} \quad (14a)$$

which gives exact results when $p^2 = g$. Table II is calculated from this relation.

The Calculation of Errors From Various Causes

Letting E_0 represent the true average value, and E_r represent that obtained from a given set of readings, the relative error in E_r is given by:

$$R.\,E. = \frac{E_r - E_0}{E_0} \quad (15a)$$

When the distribution pattern is centered in the picture area, Eq. (4a) gives the value of E_0 as $c - d/3$. If we represent the side-center distribution ratio, z_s/c by ρ, we find from (11a) that $c = p^2d/2g(1 - \rho)$, or letting $b = 1/2g(1 - \rho)$, we can write:

$$E_0 = d(p^2b - 1/3) \quad (16a)$$

Generally, E_r will have the form:

$$E_r = c - fd \quad (17a)$$

where f includes geometric and other factors.

Equation (15a) can then be written:

$$R.\,E. = \frac{1/3 - f}{p^2b - 1/3} \quad (18a)$$

Tables III and IV were calculated using this formula, with the following values for f:

A. Table III:

for 5-pt. method: $f = 0.2(1 + 1/g)p^2$
for 9-pt. method: $f = p^2/3g$
In all of these calculations $p^2 = 0.81$.

B. Table IV: Letting q represent the ratio of the distance from the center to paddle position to the distance from center to corner. The reading at the center will then be $z_c = c - q^2d$. If this reading is used to compute the side-center ratio, a slight error will be introduced which will affect the form of (16a), and therefore of (18a). With $q = 0.1$, this will amount to an error in the relative error of less than 2%, and so has been neglected.

The relative error introduced by mispositioning of the meter paddle was calculated, using (18a) as given, with $q = 0.1$ and f as follows:

for 9-pt. method: $f = q^2/3$
for 5-pt. method: $f = 2^2q/5$
for 3-pt. method: $f = q^2/3$

C. Table V: Here it was more convenient to use the differential dE for the numerator of (15a), still using the denominator as in (16a). This gives for:

9-point method:

$$\frac{dE}{E_0} = -\frac{10}{12}\,\frac{p^2}{(p^2b - 1/3)}\,\frac{dp}{p}$$

5-pt. method: $\frac{dE}{E_0} = -\frac{2}{5}\,\frac{p^2(1 + 1/g)}{(p^2b - 1/3)}\,\frac{dp}{p}$

and 3-pt. method: $\frac{dE}{E_0} = -\frac{2}{3}\,\frac{p^2/g}{(p^2b - 1/3)}\,\frac{dp}{p}$

D. Table VI: With the center of the distribution pattern in the center of the upper left quadrant of the screen at the point $A(-a/4, +b/4)$ shown in Fig. 2, the readings at the nine reading points will be as follows:

$$z_1 = z_2 = z_4 = z_5 = c - \frac{kp^2}{16}(a^2 + b^2) = c - \frac{p^2d}{4}$$

$$z_3 = z_6 = c - \frac{kp^2}{16}(9a^2 + b^2) = c - p^2d\left(\frac{1}{4} + \frac{1}{g}\right) \quad (19a)$$

$$z_7 = z_8 = c - \frac{kp^2}{16}(a^2 + 9b^2) = c - p^2d\left(\frac{9}{4} - \frac{1}{g}\right)$$

$$z_9 = c - \frac{9kp^2}{16}(a^2 + b^2) = c - \frac{9}{4}p^2d$$

Integrating the expression $z dy dx$ between the limits of $-3a/4$ and $+a/4$ for x and $-b/4$ and $+3b/4$ for y, then dividing by the area of the base ab gives:

$$E_0 = c - 7d/12 \quad (20a)$$

Substituting the values from (19a) in Eq. (5) and using $p = 1$, gives:

$$E_0 = \frac{1}{36}\,4c - p^2d\left(\frac{1}{4} + \frac{1}{4} + \frac{1}{g} + \frac{9}{4} + \frac{1}{g} + \frac{9}{4}\right) + 16c - 4p^2d\left(\frac{1}{4} + \frac{1}{4} + \frac{1}{4} + \frac{1}{g} + \frac{9}{4} - \frac{1}{g}\right) + 16c - 16p^2d\left(\frac{1}{4}\right) = c - 7d/12 \quad (21a)$$

in agreement with the true value.

When the other methods are used, the side-center ratio enters the error equations. Since this will be obtained by averaging the two unequal side readings and dividing by the center reading, it will no longer be the same as for a centered distribution. We now have

$$\rho = \frac{c - 1/4\,p^2d + c - p^2d(1/4 + 1/g)}{2c - 1/2p^2d} = \frac{4c - p^2d(1 + 2g)}{4c - p^2d} \quad (22a)$$

from which we obtain by using b as in (16a):

$$c = p^2d(b + 1/4) \quad (23a)$$

This gives:

$$E_0 = d[p^2(b + 1/4) - 7/12] \quad (24a)$$

and for each of the methods, the numerators of the error Eq. (15a) will be for the:

9-pt. method using Eq. (7):

$$E_r - E_0 = \frac{d}{12}(7 - 8p^2)$$

5-pt. method: $E_r - E_0 =$

$$\frac{d}{12}\left[7 - \frac{12}{5}p^2\left(\frac{9}{4} + \frac{1}{g}\right)\right]$$

3-pt. method: $E_r - E_0 =$

$$\frac{d}{12}\left[7 - 4p^2\left(\frac{3}{4} + \frac{1}{g}\right)\right]$$

Table VI was calculated from these relationships.

Beam-Landing Errors and Signal-Output Uniformity of Vidicons

By R. G. NEUHAUSER
and L. D. MILLER

The uniformity of signal output from a vidicon is profoundly affected by the beam-landing characteristics that result when the tube is operated in present deflecting and focusing systems. Beam-landing errors change the applied voltage on the photoconductor as a function of the deflection angle and thus determine, to a great extent, the uniformity characteristics of the signal output of these tubes. A comparison of the signal-output characteristics of the various vidicon types is made and related to the specific types of applications in which each tube will find its best usage.

THE SENSITIVITY of a vidicon should be uniform over its scanned area so that the output signals developed at all points are equal when the photosurface is uniformly illuminated. The dark current of a vidicon tube should also be uniform over the entire scanned area at any practical signal-electrode voltage. It is not possible to achieve both of these conditions simultaneously in any one of the present vidicons, principally because of beam-landing errors inherent in the vidicon electron-optical system. These errors are determined by the tube geometry and by the configurations of the fields of the deflecting and focusing coils.

Some Significant Aspects of Vidicon Operation

A vidicon which must operate at maximum effective sensitivity — when used, for example, for direct pickup of scenes having modest illumination levels — should have uniform dark-current characteristics. A vidicon having these characteristics will not produce the most uniform signal output, or sensitivity uniformity, over the scanned area. On the other hand, for applications such as film pickup, or direct pickup where the illumination levels are fairly high, and where it is primarily desirable that the signal-output uniformity be as good as possible, it is necessary to use a vidicon tube having certain photosurface nonuniformities.

This apparent inconsistency is due to the beam-landing errors that are characteristic of the vidicon camera system. (The phrase camera system is used because the effect is due to both the electron optics of the tube and the associated magnetic fields.)

The manner in which video signals are generated by a vidicon is illustrated in Fig. 1. The signal electrode has deposited on it a photoconductive material which is a good insulator in the dark. The resistivity of this material decreases when the material is exposed to light. A positive voltage is applied to the faceplate side of the photoconductor by means of the signal electrode, and the gun side of the photoconductor is scanned by a low-velocity electron beam. In the absence of light the electron beam drives the scanned area down to the potential of the thermionic cathode, so that full signal electrode voltage appears across the photoconductor. When the photosurface is illuminated by the scene to be reproduced, the resulting increase in conductivity causes a corresponding area on the scanned surface of the photoconductor to rise to positive potentials. The scanning beam then deposits sufficient electrons on the positively charged areas to drive them down to the cathode potential. The resulting flow of charges out of the signal electrode during the scanning interval develops the video signal across the load impedance.

Beam-Landing Error and Signal Uniformity

In the ideal case, the entire scanned area of the vidicon photosurface is driven down to cathode potential by the scanning beam. In practice, however, the beam drives only the center of the photosurface to cathode potential. The edges of the photosurface are driven to more positive potentials because the beam does not land exactly perpendicular to the photoconductor when it is deflected toward the edges of the tube. The magnitude of the resulting difference in voltage (called the "beam-landing error") is a function of the distance the beam is deflected away from the tube axis. This voltage difference has been measured by means of a special tube having only a signal plate on the inside of its faceplate.

Figure 2 shows the oscillograph traces obtained when the normal area is scanned, and the signal-electrode voltage is progressively increased. The curve for 1.5 v is the response when only the beam electrons having the highest velocities land at the center of the tube. The curve for 2.5 v is significant in that it represents the voltage at which all the beam electrons land in the center or undeflected portions of the scanned area. Finally, the

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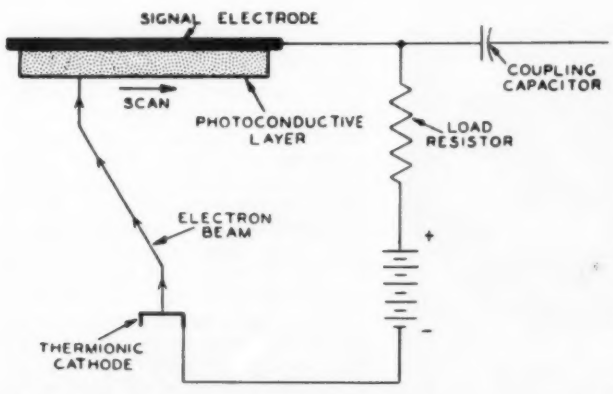

Fig. 1. Schematic illustrating vidicon operation.

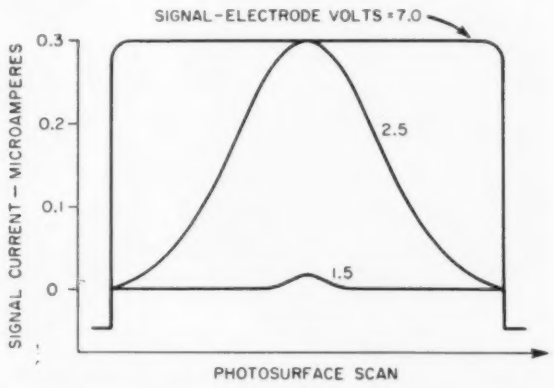

Fig. 2. Signal output as a function of signal-electrode voltage measured in a special vidicon having no photoconductor.

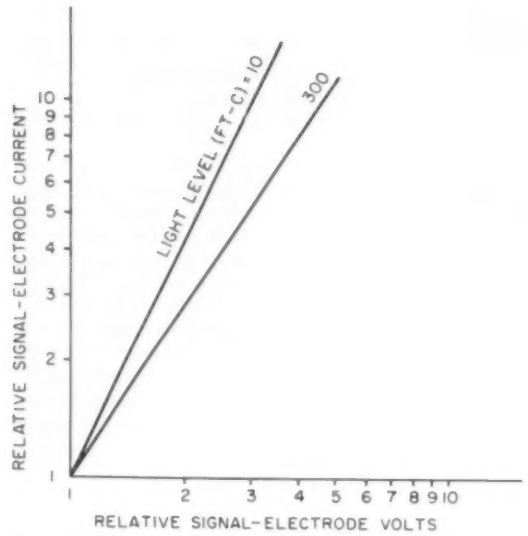

Fig. 3. Dependence of sensitivity on signal-electrode voltage at high and low light levels.

curve for 7.0 v illustrates the condition when all of the beam electrons land over the entire scanned area. The magnitude of the maximum beam-landing error is equal to the difference between the last two curves, or 4.5 v.

The importance of this beam-landing error becomes evident when one considers the dependence of the dark current and the sensitivity of the photoconductor used in the vidicon on the signal-electrode voltage. The dark current which is proportional to the dark resistivity of the photoconductor varies on a 1-in. vidicon approximately as the cube of the voltage applied across the photoconductor for dark currents in the range between 0.2 and 0.02 μamp. The sensitivity (signal-output current as a function of the applied voltage under constant illumination) varies at low-operating light levels as the square of the voltage gradient applied across the photoconductor, and at high light levels approximately as the 1.5 power of the voltage, as shown in Fig. 3.

If a vidicon having a perfectly uniform photoconductor is operated so that the dark current is very low or essentially zero, the dark-current characteristic can be ignored. These conditions are typical when a vidicon is used for film pickup. In this service, light levels of 200 to 300 ft-c are projected onto the face of the tube. If the signal-electrode operating voltage under these conditions is 40 v, the full voltage will be applied across the photoconductor only at the center of the scanned area. The voltage across the photoconductor at the edges of the scanned area is the signal-electrode voltage minus the beam-landing error voltage of 4.5 v. Because the sensitivity at light levels of 200 to 300 ft-c varies approximately as the 1.5 power of the signal-electrode voltage (see Fig. 3), the ratio of the signal-output current at the center (I_c) to that at the edges (I_e) of the scanned area can be expressed as:

$$\frac{I_c}{I_e} = \frac{(40)^{1.5}}{(40-4.5)^{1.5}} = 1.20$$

The signal-output current for uniform illumination, therefore, is 20% greater at the center than at the edges of the scanned area.

For direct pickup work, however, vidicons are operated with considerably lower light levels on the faceplate. At a faceplate illumination of 10 ft-c, the sensitivity varies as the square of the applied signal-electrode voltage, as shown in Fig. 3. The dark current under these conditions is only one-tenth the signal current and can be neglected. Signal-output uniformity under these conditions would be somewhat poorer than under the conditions of high illumination if the same value of 40 v is assumed as the signal-electrode operating voltage. Under these conditions

$$\frac{I_c}{I_e} = \frac{(40)^2}{(40-4.5)^2} = 1.25 \text{ or } 25\% \text{ error}$$

Output-signal uniformity, however, is also affected by the absolute value of the signal-electrode voltage. For example, if the photoconductor is made thick enough to permit operation at twice the signal-electrode voltage used under the extremely low dark-current conditions assumed in the first example, the ratio of signal-output current at the center to that at the edges would be:

$$\frac{I_c}{I_e} = \frac{(80)^{1.5}}{(80-4.5)^{1.5}} = 1.09$$

This operating condition results in signal output only 9% higher at the center than at the edges of the raster. Figure 4 is a curve of output-signal error as a function of signal-electrode voltage for both high- and low-illumination levels. These curves show the effect of the beam-landing error and the effect of the signal-electrode operating voltage on the performance of a vidicon. It is evident that output-signal uniformity is better at the higher signal-electrode operating voltages. However, there is an upper limit to the signal-electrode operating voltage that can be used for present vidicons. This limit is the result of a phenomenon called "edge crawl" or "waterfall effect" which appears when the signal-electrode voltage is above about 100 v. This phenomenon produces annoying irregular disturbances at the edges of the picture.

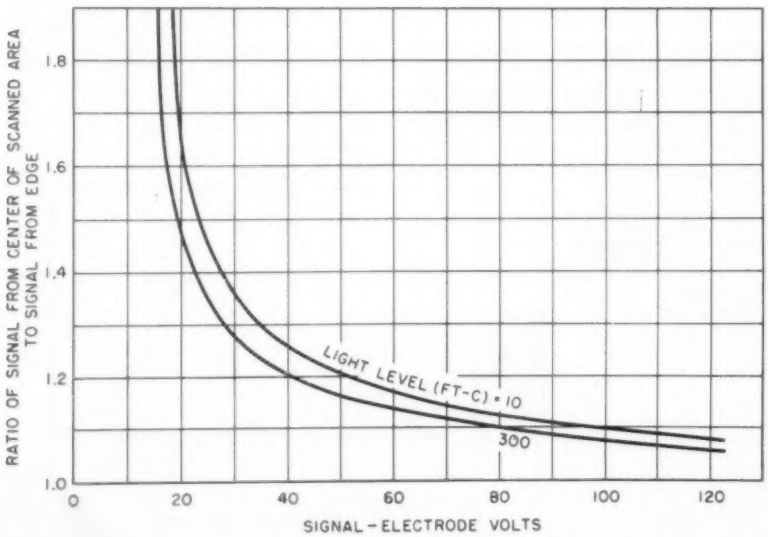

Fig. 4. Beam-landing error as a function of signal-electrode voltage at high and low light levels.

Beam-Landing Error and Dark-Current Uniformity

The dark current as shown in Fig. 5 varies approximately as the third power of the signal-electrode voltage. In the strictest sense, the dark-current uniformity should probably be expressed in terms of the voltage gradient through the photoconductor rather than the signal-electrode operating voltage because thick surfaces behave in the same manner as thin surfaces, except that the voltage required for a given amount of dark current varies directly as the thickness of the photoconductor. As shown by Fig. 5, the curves for the thin and thick photoconductor have the same slope, but have markedly different operating voltages.

For a uniformly thick photoconductor, the dark-current uniformity will be affected by both the beam-landing error and the signal-electrode operating voltage. For example, for a signal-electrode operating voltage of 40 v, the ratio of dark current at the center (I_{dc}) to that at the edges (I_{de}) of the photoconductive layer is:

$$\frac{I_{dc}}{I_{de}} = \frac{40^3}{(40 - 4.5)^3} = 1.43$$

For a signal-electrode operating voltage of 80 v, this ratio is:

$$\frac{I_{dc}}{I_{de}} = \frac{80^3}{(80 - 4.5)^3} = 1.21$$

Because the dark current is normally only a small fraction of the signal current, these dark-current errors are small compared to the signal-current errors. When a tube is operated so as to obtain maximum sensitivity, however, the dark current and the dark-current nonuniformities become very significant.

Uniformity of Thickness of the Photoconductive Layer

The uniformity of thickness of the photoconductive layer of a vidicon has a strong influence on the uniformity of both its signal-output and its dark-current characteristics. Dark current and sensitivity depend upon the voltage gradient across the photoconductor. Any nonuniformities in the thickness of the photoconductor produce nonuniformities in the voltage gradient in inverse proportion to the thickness. Because sensitivity varies as the square of these thickness or voltage-gradient variations, and dark current varies as their cube, the effects of these variations are similar to those of beam-landing errors which modify the absolute voltage applied across the photoconductor and thus modify the voltage gradient.

Vidicon Types 6198 and 6326

The signal-output uniformity of vidicon types such as the 6198 and 6326 when operated with low dark currents and signal-electrode voltages of about 20 to 40 v is, in general, better than predicted by the foregoing analysis of beam-landing errors alone. This apparently better signal-output uniformity is due to the rather delicate balance maintained between photosurface nonuniformity and the inherent beam-landing errors. The photosurfaces of these tubes are thinner at the edges than in the center and therefore have higher voltage gradients at the edges than in the center. As a result, they tend to have maximum sensitivity at the edges, thereby balancing the effect of the lower applied voltage in these regions resulting from beam-landing errors.

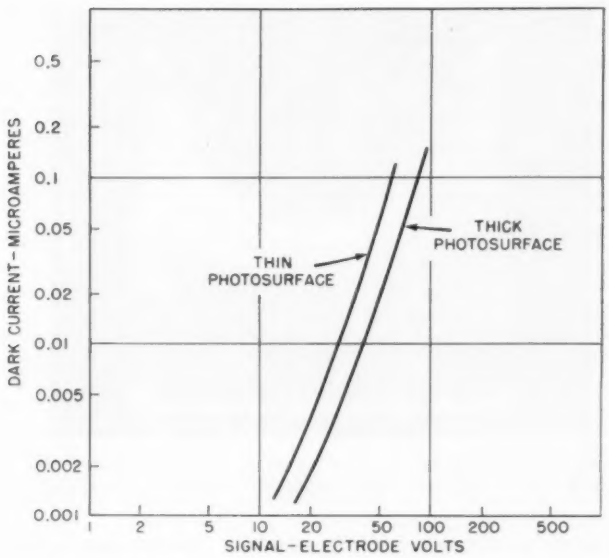

Fig. 5. Dark-current characteristics.

The nonuniformity of the photoconductor is evident in the photograph of the photosurface given in Fig. 6A. This nonuniformity is characteristic of a photosurface deposited by an evaporator inserted through the side tip. When an attempt is made to operate these tubes at higher dark current and higher signal-electrode voltages to achieve higher effective sensitivity, the dark current becomes appreciable and the tube exhibits a definite dark-current flare which is far from desirable. This flare, illustrated in Fig. 7, is due to the dark current varying as the third power of the uneven voltage gradients across the uneven photosurface. These types cannot be "driven" hard to get improved sensitivity because of the very feature that produces fairly uniform signal output when the tubes are operated with low dark currents.

Vidicon Types 6198-A and 6326-A

The 6198-A and the 6326-A vidicon types, as shown in Fig. 6, have more uniform photoconductors than their prototypes because they are made by improved manufacturing techniques

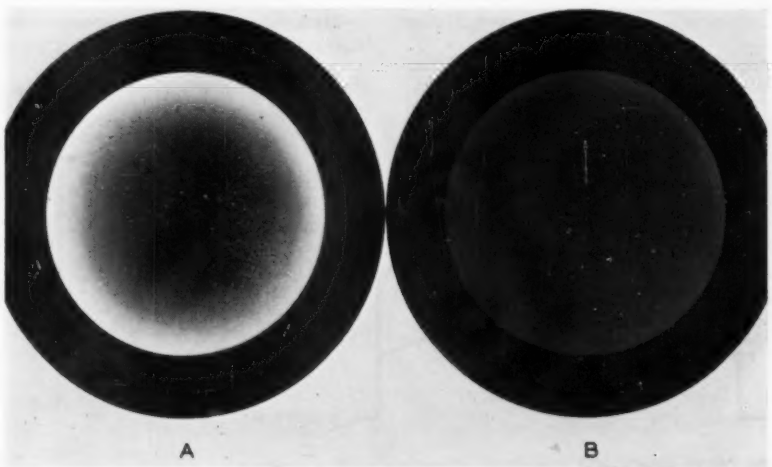

Fig. 6. The vidicon faceplate: A, nonuniform photosurface (Type 6198) 6326; B, uniform photosurface (Type 6198-A) 6326-A.

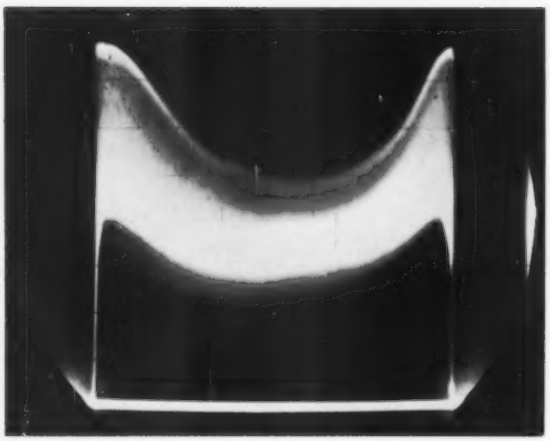

Fig. 7A. Oscillograph trace of signal output of Type 6198 or 6326, illustrating flare under conditions of high dark current.

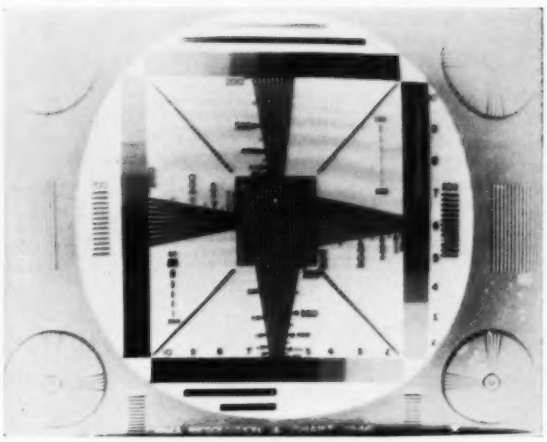

Fig. 7B. Effects of flare under conditions of high dark current on test pattern picked up with Type 6198 vidicon.

which permit control of a number of processing variables. By this method of manufacture it is also possible to produce tubes having more uniform dark-current characteristics, in that the dark current will not produce a flare at the edges when higher voltages are applied to the photoconductor. However, signal-output uniformity or sensitivity over the scanned area of such a tube will not be uniform when it is operated at low dark currents and lower values of signal-electrode voltage. This condition was previously illustrated by the calculations of the effects of beam-landing error on signal-output uniformity of a uniform photoconductor.

New Vidicons

A developmental vidicon now being evaluated is designed to operate at high values of dark current.* When this tube is operated with relatively high dark current to obtain maximum sensitivity (the usual condition when a vidicon is used for live pickup), the dark current becomes an appreciable part of the total current and cannot be neglected. Under these conditions the signal-output current will consist of two nonuniform components of approximately equal amplitude: the dark current and the actual signal current (see Fig. 8).

This developmental tube has an extremely uniform photoconductor surface. As a result, when used with beam-landing error correction as described in a later section, it is capable of developing a very uniform signal output and dark current. Highest sensitivity is obtained from this tube when it is operated with dark currents of 0.2 μamp. The sensitivity gain is nearly doubled when the dark current is increased from 0.1 to 0.2 μamp. When the beam-landing errors in this tube are canceled out, the good signal-output uniformity and dark-current uniformity remain constant at the different signal-electrode voltages that are necessary for the various types of service for which these tubes can be utilized.

Design of a Tube for Particular Application

Those who have had experience with the operation of vidicons will realize that a given vidicon can be operated over a wide range of signal-electrode voltages and illumination levels. The performance of the tube, however, will vary appreciably with the signal-electrode operating voltage. It is also evident from the preceding discussion of beam-landing errors that the signal-electrode voltage should be as high as possible under any operating condition, so that the beam-landing errors will be at a minimum. Although any vidicon can normally be operated over a 3-to-1 range of signal-electrode voltages, it is apparent that no one vidicon type can perform well in every type of operation.

The signal-electrode voltage will either be too low for best performance at low signal-electrode voltages, such as for film pickup, or it will be too high when the tube is operated to produce maximum sensitivity. For example, a tube which requires 90 v for maximum sensitivity will require about 30 v for film service. Further, if this tube were made with a uniformly thick photoconductive surface, the landing errors would produce objectionable signal-output nonuniformity when operated for film

* L. D. Miller and B. H. Vine, "Improved developmental one-inch vidicon for television cameras," companion paper in this *Journal*, presented at SMPTE Convention, Philadelphia, October 9, 1957.

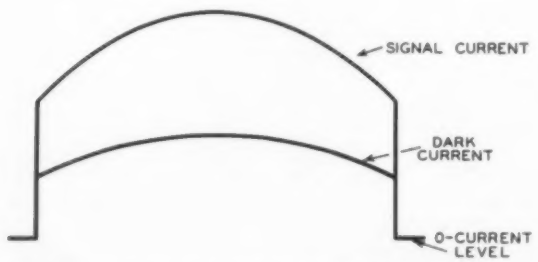

Fig. 8. Output-signal waveform of vidicon with a uniform photoconductor operated under high dark-current condition.

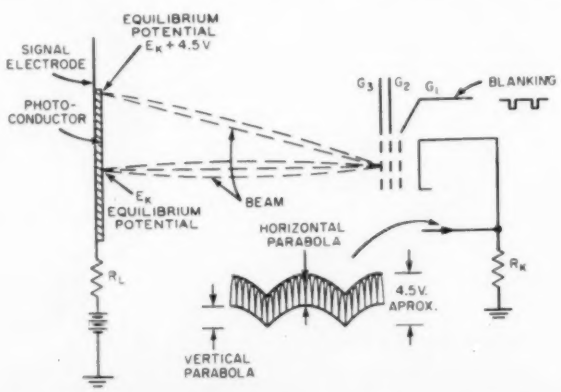

Fig. 9. Cathode-modulation circuit and waveforms necessary for correction of beam-landing error.

service. If, instead, it were made with a nonuniform photosurface designed to complement the beam-landing error and produce a uniform signal output at the lower signal-electrode voltage, it would have objectionable flare when operated at higher signal-electrode voltages.

In the present state of the art, therefore, it would be more satisfactory to use a tube especially designed for each type of operation. Types such as the 6198-A and 6326-A, useful for maximum sensitivity operation, have a uniformly thick photoconductor, and operate at a signal-electrode voltage of up to 90 v with a tolerable level of background or dark-current nonuniformity.

Vidicon types for film pickup service are made with photoconductors having a graded thickness such as in the 6326 and can be operated at lower values of signal-electrode voltage and dark current. An alternative would be to use a uniformly thick photoconductor which produces very low dark currents when operated at the higher signal-electrode voltage (70 to 100 v). In such a type, the beam-landing errors would be reduced and an extremely flat dark current and low-lag characteristics would result. However, such a type would probably not be suitable for uses requiring high sensitivity because the signal-electrode voltage would have to be operated in the 150- to 200-v range, which is generally unsatisfactory because of "edge crawl" or "waterfall effect" problems.

Landing-Error Correction Techniques

There is a rather simple solution for the problem of beam-landing errors in vidicons. The solution requires certain circuit changes or additions and consists of supplying a modulating voltage of suitable waveform to the cathode of the vidicon. As explained previously, the scanning beam drives the surface of the photoconductor to approximately cathode potential plus some voltage which is proportional to the deflecting angle. A suitably shaped waveform can therefore be applied to the cathode so that the equilibrium potential of the scanned area is essentially constant. The shape and amplitude of such a waveform is shown in Fig. 9. The correction voltage is a combination of negative-going parabolas at the vertical and horizontal scanning frequencies which reduce the cathode potential when the scanning beam approaches the edges.

In this manner, variation in the potential across the photoconductor caused by the beam-landing error can be "flattened out." The precise waveform and the amplitude required will depend on the characteristics of the deflection system and should be determined individually for each system. A further refinement of this technique may be made by applying an identical waveform to the grids Nos. 1 and 2 of the vidicon, to cancel any modulation of the beam current produced by the correction voltage applied to the cathode.

This method of correction for beam-landing errors provides a further bonus in that it improves the center-to-edge focus. Because the cathode is driven more negative by the parabolic correction voltage as the beam is deflected toward the edges of the scanned area, the strength of the accelerating field increases correspondingly and speeds up the electron beam. In the vidicon, the deflected beam has to travel a further distance to reach the photoconductor than does the undeflected beam and, therefore, comes to a focus slightly to the rear of the desired plane. By increasing the velocity of the beam as it is deflected, it is possible to push the point of focus forward toward the photoconductor and thus obtain improved center-to-edge focus.

This type of correction can be used with any vidicon-camera system and, when properly used, eliminates the dark corners ("porthole" effect) which appear when the tube is operated at the lower signal-electrode voltages. It also maintains substantially constant signal output over the useful range of signal-electrode operating voltages. This technique permits the vidicon types that have a uniform photoconductor to be used for both film and maximum sensitivity operation, since the beam-landing errors are canceled out. When cathode modulation is used, the dark current and signal uniformity are substantially independent of the signal-electrode operating voltage.

When this method is used in a color system, the same correction waveform must be applied to all three vidicons in the color camera to prevent corner misregister. Experience in the operation of vidicons shows that there is a slight rotation of the image as the electrical focus is varied. The image also rotates when the focus is changed by cathode modulation. Identical waveforms applied to the three vidicons will assure tracking of the rotation of the images on the three tubes and will result in good corner registration.

Cathode modulation has been used in the past to correct for nonuniformity of the *photoconductor* to achieve better signal-output uniformity. Although this technique was somewhat successful, it suffered from a basic limitation, particularly in color systems where precise register as well as uniform signal output is important. The principal difficulty was that each of the three vidicons required a different correction waveform to compensate for the variations in its *photoconductor*. These different requirements resulted in corner misregister. Another difficulty was that the correction voltage required to obtain uniform output was of such a polarity in some instances that it deteriorated rather than improved the focus in the corners.

The value of cathode modulation is for correction of beam-landing errors. When used for this purpose alone, and included as a fixed operating parameter in the camera, it should be a very useful tool.

Improved Developmental* One-Inch Vidicon for Television Cameras

By L. D. MILLER
and B. H. VINE

An improved developmental 1-in. vidicon for use in live and film pickup is described. The design features of this tube result in a higher degree of uniformity of characteristics from tube to tube and, therefore, make it possible to obtain better register in color cameras. These features are a result of the development of an extremely uniform photoconductive surface and precision design.

Methods of compensation for beam-landing errors, which are responsible for most of the nonuniformities in signal output of vidicons, are explained. This paper describes a method of operation which, with proper circuit design, can be utilized to obtain the higher sensitivity required for live pickup. Tentative performance data are given and compared with those for present vidicon-type camera tubes.

THIS NEW developmental vidicon* utilizes an electron-gun structure and photoconductive material similar to those in present commercial vidicons. The new tube is particularly suitable for use in 3-vidicon color cameras for live pickup. It also shows excellent potentialities for use in black-and-white cameras operating at low illumination levels and in both black-and-white and color film cameras.

Design Features

A photograph of the new vidicon is shown in Fig. 1. It is the product of newly developed processing and fabrication techniques which permit the use of a precision design using nonmagnetic materials throughout, an extremely flat faceplate free from optical distortion, and a tipless envelope similar to that used for the 6198–A and 6326-A, which makes it possible to use deflecting and focusing components producing highly symmetrical fields.

The tube is capable of higher effective sensitivity because of its ability to be operated with higher values of dark current and signal-electrode voltage than are permissible with present vidicons. The uniform thickness of the photoconductive layer used assures a substantially constant voltage gradient and uniform dark current across the scanned area. This feature also permits the new tube to produce a signal current great enough to provide a high signal-to-noise ratio even when used at low light levels. The dark current, although high, is substantially uniform and, therefore, provides a substantially constant signal which can be clipped off to establish proper black level. The degree of improvement in photosurface uniformity is shown by the photographs in Fig. 2.

The new vidicon is free from objectionable lag in response to changing light even when operated at high signal-electrode voltage and low light levels. While in present vidicons lag increases with decreasing light and increasing signal-electrode voltage, in the new tube lag reaches a maximum at a dark current of 0.1 μamp and then levels off.

Because of the uniform thickness of its photoconductive surface the new tube also produces a signal of substantially constant amplitude over the entire scanned area when subjected to uniform illumination. Signal amplitude under these conditions is not absolutely constant, primarily because of certain beam-landing errors inherent in all vidicons.† These errors, however, vary very little from tube to tube, so that a good signal match can be obtained when the new vidicon is operated in 3-vidicon color cameras. Furthermore, these errors can be canceled out by a correction voltage applied to the vidicon cathode as described in the companion paper.

The preciseness of construction and the elimination of magnetic materials in the front end of the new tube help minimize geometrical distortion of pictures and simplify considerably the problem of obtaining and maintaining register in color-camera systems.

High-Sensitivity Operation

The fact that the signal-output current of the photoconductor increases approximately as the 1.6 power of the signal-electrode voltage is used to advantage in the new vidicon. The extremely uniform thickness of the photoconductive layer allows the signal electrode to be operated at approximately twice the voltage that is considered proper for present vidicons. As a result, the light level required to provide a given signal output is decreased by a factor of 5 to 6, with a corresponding gain in effective

Presented on October 9, 1957, at the Society's Convention at Philadelphia, by L. D. Miller (who read the paper) and B. H. Vine, Electron Tube Div., Radio Corp. of America, Lancaster, Pa.
(This paper was received on November 25, 1957.)

* This tube has subsequently been designated the RCA 7038 and is now a commercial product.

† R. G. Neuhauser and L. D. Miller, "Beam-landing errors and signal-output uniformity of vidicons," *Jour. SMPTE, 67:* 149-153, Mar. 1958.

Fig. 1. The improved developmental vidicon.

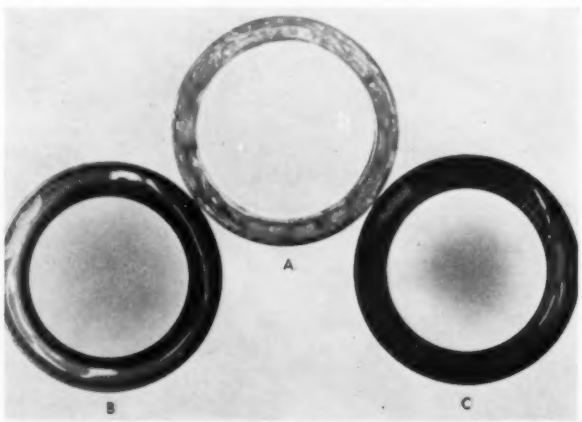

Fig. 2. Photosurface uniformity of A, developmental; B, Types 6198-A or 6326-A; and C, Types 6198 or 6326.

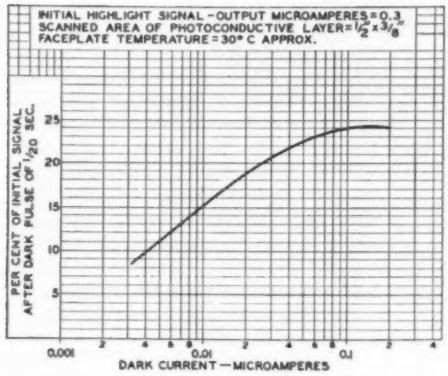

Fig. 3. Lag characteristics.

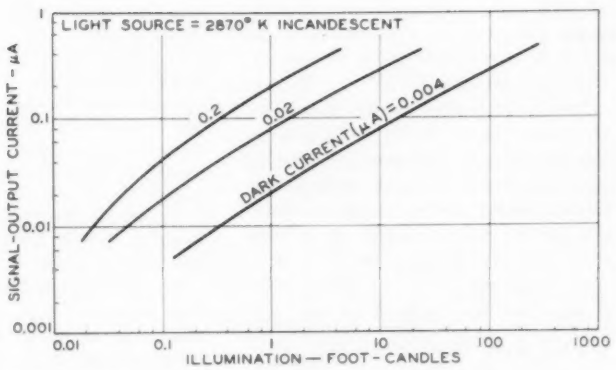

Fig. 4. Light-transfer characteristics.

sensitivity. The dark current increases as the 3.3 power of the signal-electrode voltage at high values of dark current. The dark current of the new tube for maximum sensitivity operation is, therefore, approximately 0.2 μamp, or 10 times as great as the maximum-sensitivity value for present types. Because of the uniform thickness of the photoconductor, however, the dark current of the new tube is substantially constant over the entire scanned area.

It is not recommended that this new tube be operated at signal-electrode voltages and dark currents higher than those shown, because overall picture quality decreases with increasing dark current, i.e. the beam current, and, therefore, the beam diameter, increase very rapidly as the total signal output increases, resulting in decreased resolution capability. Furthermore, at high dark-current levels any structural defects in the target have more pronounced effects and the photosurface is more susceptible to raster and image "burn."

Beam-Landing Errors

The beam-landing errors in this tube are similar to those in commercial vidicons. The effects of the beam-landing error on the uniformity of signal and dark current are similar to those described in the reference cited above. The use of suitable cathode-modulation waveforms with this tube will permit the tube to operate over the wide range of signal-electrode voltages necessary for use in both film and live pickup work. Little change in dark current or signal uniformity will result when the tube is operated at the different signal-electrode voltages required for these different types of service.

Lag Characteristics

In the operation of a vidicon, the lag in response to changing light will increase as the signal-electrode voltage or the dark current increases. In this developmental vidicon, however, it has been found that this lag will increase until the dark current reaches 0.1 μamp and then level out and remain almost constant above 0.1 μamp dark current. Figure 3 shows that the tube has a lag of 18% at 0.02 μamp dark current and a lag of only 24% at 0.2 μamp dark current.

Film-Pickup Operation

Although the high-sensitivity feature of this vidicon is not needed for film pickup, the new tube is advantageous for this application. The uniform signal output of this tube, when maintained with the beam-landing error-canceling technique described in the companion paper, is desirable for both monochrome and color film cameras. For color, this uniformity and the consequent similarity of uniformity from tube to tube should permit any three of these tubes to give a correct color match in a 3-vidicon color camera. The precision mechanical design will also facilitate register in such cameras.

Tentative Performance Data

The preceding description has shown that the developmental vidicon, when properly operated, has satisfactory lag characteristics and high sensitivity. Figure 3 shows that the lag of the new tube when operated at a dark current of 0.2 μamp

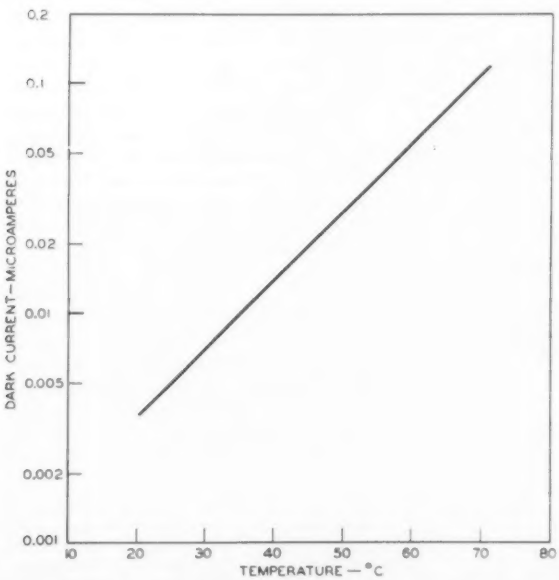

Fig. 5. Variation of dark current with temperature.

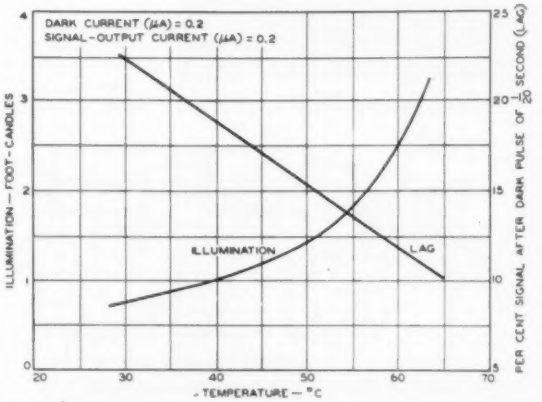

Fig. 6. Performance characteristic as a function of temperature.

for maximum sensitivity is only slightly greater than the lag of present commercial vidicons, and that it can be used for most applications.

The light-transfer characteristics of the new tube are shown in Fig. 4. The gamma characteristics are similar to those of commercial vidicons and remain relatively constant over the range of operation. When the signal-electrode voltage is adjusted for a dark current of 0.02 μamp, approximately 5 ft-c of high light illumination are required on the faceplate for a normal signal-output current of 0.2 μamp.

For operation at 0.2 μamp dark current, a high light illumination of approximately 1 ft-c is required on the faceplate for the same signal-output current.

The limiting resolution of the new vidicon when operated with a dark current of 0.02 μamp or lower is about 700 lines. When operated at a dark current of 0.2 μamp, the limiting resolution is reduced to about 600 lines because of the increased beam current required. The spectral response of the new tube covers the entire visible spectrum and is similar to that of present commercial vidicons. This spectral response assures accurate color translation when the tube is used in a color camera having appropriate color filters and optical arrangements.

Temperature is an important consideration because the dark current is sensitive to temperature, as shown in Fig. 5. To maintain the dark current constant with increasing temperature, it is necessary to reduce the signal-electrode voltage. Although this reduction in signal-electrode voltage decreases the sensitivity, it also results in less lag. The variation of light required for a given signal-output current and a curve of the variation of lag with temperature are shown in Fig. 6.

It is desirable to select an operating temperature which provides the best balance between lag and sensitivity. The tube should be held close to this temperature to assure stability of black level and signal-output level. Another means is the use of temperature-compensating circuit elements which automatically adjust the signal-output and dark-current levels.

To achieve optimum performance from the new vidicon, special consideration must be given to the design of cameras and other associated equipment. Because of the high dark-current level, video amplifiers must be designed to handle larger input signals than are necessary for present vidicons. To assure dark-current uniformity, deflection systems must have an extremely high degree of linearity. To assure that the tubes are set up at the correct dark-current levels, means must be provided for measurement of d-c signal-output current. To assure consistent performance, the operating temperature of the vidicon tube should be held constant, or temperature-sensitive circuits should be employed to maintain constant signal-output level and black level.

Conclusion

It can be seen that the new vidicon has basic performance characteristics which are desirable in a camera tube for use in 3-vidicon, live-pickup color cameras. It also has characteristics which are desirable for pickup of both monochrome and color film, provided suitable correction voltages are applied to its cathode, and for most industrial television applications. Its outstanding features are its high effective sensitivity, uniform signal output, and precision design.

Acknowledgments

Acknowledgments are due to the following members of the RCA Electron Tube Division at Lancaster, Pa.: F. S. Veith, R. G. Neuhauser and T. E. Benner of the camera-tube design activity, and H. M. Hambleton of the manufacturing activity for his assistance and guidance in the design and development of the new tube; and to S. Lasof and G. A. Robinson of the camera-tube application activity for their assistance in the evaluation of the performance and quality characteristics of the new tube.

H. N. Kozanowski and T. Shipferling of the Commercial Electronic Products Div. of RCA, at Camden, N.J., also contributed in the evaluation of the performance of the tube.

Discussion

Robert Sammon (from Ed. Murrow's "Person to Person" Show in New York): Since the reduction in the size of the equipment we use on our home visits is directly tied to the use of a more sensitive vidicon, do you anticipate that in the near future there will be a vidicon on the market that will produce substantially as good pictures as the present image orthicons at light levels on the order of 65 foot-candles?

Mr. Miller: This tube still does not come up to the image orthicon in effective sensitivity.

Mr. Sammon: Is developmental work being done on a vidicon that would eventually get one that would come out about 65 foot-candles? Which is about as much light as we can use in anybody's home.

Mr. Miller: That's 65 foot-candles on the scene?

Mr. Sammon: Yes, on the scene.

Mr. Miller: It would be quite a bit less on the faceplate of the tube, is that right?

Mr. Sammon: I assume so.

Mr. Miller: I don't believe that there will be a vidicon out for that operation.

(*Anon.*): I think there is more application for this tube, usefully, in just what Bob Sammon is asking about. We are quite interested, in fact we have some on order to try out, so there will be answers to that fairly soon.

A Stabilized Monitor for Color Television Picture Quality Control

By E. E. GLOYSTEIN
and N. P. KELLAWAY

A new color monitor has been designed to serve both as a high-quality picture display device and as an instrument for judging the quality of color TV signals. It incorporates several significant design innovations, both electrical and mechanical. The highly stabilized circuits provide a picture of excellent quality. The control panel has been designed for simplicity of operation, and the mechanical design provides good accessibility for maintenance. The monitor is designed as a major tool for use in color TV plants.

A BASIC TOOL needed by the technicians responsible for the quality of color television signals is a color display device capable of producing high-quality pictures, stable enough to hold its adjustments over long periods, and rugged enough to stand up under rigorous operating conditions. This need can now be met by the TM-21 Color Monitor, recently introduced by RCA. The TM-21 is the first instrument designed to serve both as a color picture display device and as a piece of test equipment. It is expected to have many applications as an adjunct to color camera chains, as a general-purpose monitoring instrument, and as a high-quality display device in "prestige" applications, such as clients' booths and reception rooms.

The Importance of Stability

Very strong emphasis has been placed on stability in the design of the TM-21. It is not enough to make a color monitor merely capable of *producing* a high-quality color picture — it must be capable of *maintaining* such a picture over long operating periods without frequent readjustments to compensate for circuit drifts. While great progress has been made in reducing color television to a science, there is still enough "art" mixed with the science to make necessary many adjustments in cameras and transmitting apparatus, on the basis of what they do to the color picture. Unless the operators who make such adjustments are provided with a highly stable color monitor, they can never be quite sure whether some of the effects they see in the pictures are faults of the signal or of the display device.

It must be emphasized that stability in an electronic device does not just happen — it must be designed in. A high degree of stability has been achieved in the TM-21 by the combination of three design approaches: (a) simplification of the basic circuit configuration to reduce to a minimum the possible sources of drift; (b) the use of inverse feedback wherever possible; and (c) the use of highly conservative design practices with generous reserve factors in cases where feedback is not practical.

Overall Design Aspects

The front-view photograph of the TM-21 (Fig. 1) shows some of the more obvious aspects of the design. The size of the monitor is determined primarily by the 21-in. color kinescope. Actual cabinet dimensions are 27 in. wide, 33 in. high and 28 in. deep. The only operating controls normally exposed are those for brightness, contrast and the power off-on switch. Internally, the monitor consists of five main chassis mounted on a sturdy frame. Figure 2 shows in block diagram form the relationships between these chassis. The functions of the five chassis may be described briefly as follows:

(1) The *decoder* processes the composite color signal to derive red, green and blue signals suitable for controlling the color kinescope. It also contains a sync separator and a sync interlock circuit, permitting optional use of external synchronizing pulses.

(2) The *output amplifiers* increase the amplitudes of the signals delivered from the decoder to the levels needed to drive the electron guns of the kinescope. They also provide for the restoration of the d-c components of the signals.

(3) *The deflection and high-voltage chassis* is controlled by pulses supplied from the decoder chassis. It provides the sawtooth currents for the deflection yoke of the color kinescope, plus a source of regulated power at 25 kv for the kinescope ultor. The protection circuits, which prevent damage to the kinescope from certain types of failure or improper operation, are located within this unit.

(4) The *convergence chassis* develops second-order deflection currents, which are applied to the convergence yoke on the color kinescope for the purpose of adjusting the shapes of the red, green and blue rasters so that they may be properly registered in all parts of the picture.

(5) The *power supply* provides regulated +B power for the other chassis.

Mechanical Design

Figure 3 shows how the chassis are mounted within the main frame. Excellent serviceability is achieved by mounting the four major chassis vertically with the tubes projecting inward. This design makes it possible to replace any tube from the top or rear of the monitor, and provides ready access to all small components and wiring by the simple removal of side covers. The same design configuration also provides good separa-

Fig. 1. Front view of the RCA TM-21.

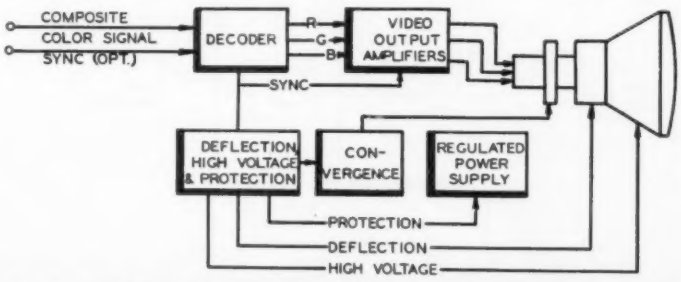

Fig. 2. Overall block diagram, showing the five major chassis in the TM-21.

Presented on October 9, 1957, at the Society's Convention at Philadelphia by E. E. Gloystein and N. P. Kellaway (who read the paper), Radio Corporation of America, Bldg. 10–3, Commercial Electronic Products, Camden 2, N.J.
(This paper was received on February 13, 1958.)

Fig. 3. Rear-quarter view of the monitor with side and top covers removed, showing how the chassis are mounted within the main frame.

tion of heat sources from temperature-sensitive components, so that adequate cooling is possible with natural convection currents. The mounting frame is made of sturdy aluminum angles, and is so designed that the monitor may be placed on any of its six surfaces without damage. It is significant, however, that it is unnecessary to gain access to the bottom of the monitor for any normal service functions.

As viewed in Fig. 3, the deflection and high-voltage chassis is mounted at the lower left, with the power supply immediately above it. The decoder is at the lower right, mounted below the output amplifiers. Not shown in Fig. 3 is the convergence chassis, which is mounted as a subassembly just behind the middle portion of the front panel. The kinescope is mounted directly to the upper section of the front panel, which is hinged at the bottom, so that it can be dropped forward to permit convenient replacement of the kinescope.

Decoder

The area in which the TM-21 differs most significantly from conventional monitor or receiver designs is in the decoder, which separates the compatible color signal into its red, green and blue components. The basic functions of a decoder are illustrated by the generalized block diagram (Fig. 4). The input signal is first split into four separate parallel channels. One of these is the burst-controlled oscillator, which generates the *CW* carriers needed to demodulate the *I* and *Q* chrominance signals. The *I* and *Q* channels contain demodulators and filters, while the monochrome channel usually involves a subcarrier trap, an aperture compensator (or "high peaker") and a delay compensating network. Three of the signal paths are brought together again in the matrix network, which cross-mixes the *M*, *I* and *Q* signals to produce red, green and blue signals. The decoder output signals are then amplified to the the levels necessary to drive the color kinescope.

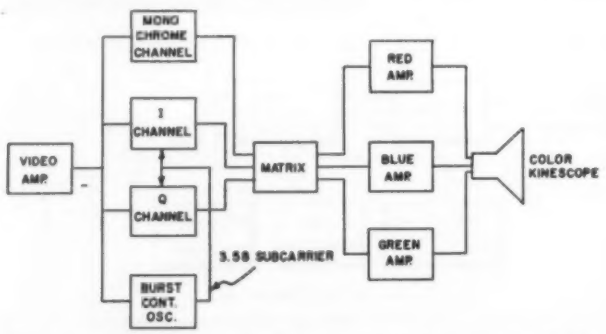

Fig. 4. Generalized block diagram illustrating the decoding process in a color monitor or receiver.

Many of the drift problems in conventional color monitor or receiver designs occur in the decoder section, because the parallel signal paths are often subject to different variations in gain or phase. In the decoder, shown in Fig. 5, drift problems have been kept under control by reducing to a bare minimum the number of stages required in the separate but parallel paths, by eliminating the need for gain in the separate parallel paths and by stabilizing the individual stages.

The heart of the decoder design is a stabilized "video-driver" stage which drives the monochrome channel and the burst-controlled oscillator from its plate circuit, and the two chrominance demodulators from its cathode. The d-c component is restored at this stage by means of a feedback stabilized clamp. One of the gating stages involved in this feedback clamp has been made to serve as a burst separator as well, thus eliminating a separate tube for this function. The video driver itself is so designed that the plate signal current is inherently equal to the cathode signal current, so there is no possibility of changes in the tube characteristics causing gain variations in the plate circuit relative to the cathode circuit.

Prior to the video-driver stage, the input signal is raised to a relatively high level (about 12 v, peak-to-peak) by an amplifier equipped with a nonselective or wideband gain control. This high level at the driver stage plays an important role in solving the overall stability problem, because it means that virtually all of the voltage gain required in the entire decoder is supplied by an amplifier which handles all signal components simultaneously, thus eliminating the problem of matching the gains of several individual amplifiers.

In the stages which follow the video driver, which must necessarily be split into separate channels, it is possible to sacrifice voltage gain for the sake of stability and still deliver signals at about a 1-v level at the output of the decoder. The amount of degeneration (or feedback) that it has been possible to incorporate by following this approach has even made practical the omission of several conventional gain controls normally provided in decoders to compensate the circuit variations.

As noted above, there are four main-

circuit channels following the video-driver stage. One of these is the burst-controlled oscillator, consisting of a crystal-controlled 3.58 oscillator shunted by a reactance tube whose control voltage is derived from a phase detector which compares the oscillator output with the separated bursts provided by the video driver. Special attention has been given to drift problems in this oscillator, so that the phase of its output remains stable relative to the phase of the chrominance signal delivered from the cathode side of the video driver.

In conventional decoder designs, the burst-controlled oscillator normally delivers two subcarrier outputs, 90° apart in phase, to the chrominance demodulators. (A popular method of deriving the two outputs is to use a pair of tuned circuits, one tuned above resonance and the other below resonance to achieve the required 90° phase shift.) In the TM-21 decoder, however, a potential phase stability problem has been avoided by providing only a single output from the oscillator, which is tied directly to both demodulators, so that there can be no relative phase drift between them.

The required 90° phase shift is provided in the *video* channel, by passing the input signal to the *I* demodulator through a precision delay line equivalent to 90° at 3.58 mc. This delay line can be manufactured with a tolerance of only ±1 degree, so it has been possible to eliminate the conventional 90° or quadrature phase control. The presence of this delay line in the *I* video channel poses no problem, because it is very simple to take it into account when adjusting the total delay of the *I* channel relative to the narrowband *Q* channel.

The demodulators used are nothing more than fast-acting diode clamps, keyed at a 3.6-mc rate. The major advantages of these demodulators are: (1) they have no video-gain drift problem, since they behave in principle like fast-acting passive switches, and (2) they are insensitive to the level of the *CW* subcarrier signal, provided the *CW* signal is always of higher amplitude than the modulated subcarrier signal.

There are several unusual features in the monochrome channel of the decoder, driven from the plate side of the video driver. There is, first of all, a clipper in the plate circuit which removes both the sync and burst components of the input signal. In the blanking interval thus cleared, there is provision for adding a "brightness control pulse" of adjustable amplitude as shown in Fig. 6. This pulse is derived from separated sync, and makes possible a considerable simplification in the adjustment of the monitor for proper gray-scale balance. Since the pulse is introduced in the monochrome channel ahead of the matrixing operation, it is automatically supplied in the proper

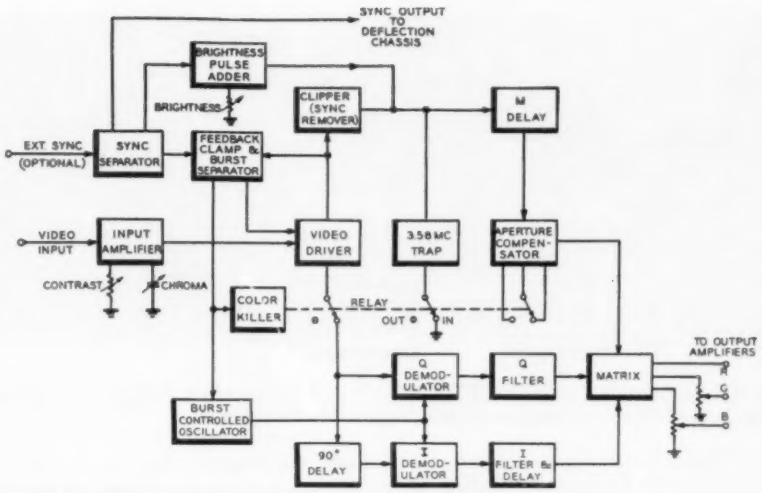

Fig. 5. Simplified block diagram of the TM-21 decoder.

proportions to the red, green and blue channels which are separated at the output of the matrix. The brightness pulse serves as a reference level to which the signals are clamped in the d-c restoration process at the kinescope guns.

As in all compatible color display devices, it is necessary to provide attenuation in the monochrome channel to prevent the subcarrier component of the signal from reaching the kinescope by this path. In the TM-21, this need is met by a simple trap circuit. When the monitor is operated from a monochrome signal (i.e. one without color sync bursts), the "color killer" not only disables the chrominance channels to avoid crosstalk effects, but also removes the trap from the monochrome channel, permitting substantially higher resolution. This feature is of considerable value in situations where the monitor is used for viewing both monochrome and color pictures.

A delay line is needed in the monochrome channel to compensate for the greater delay of the *I* and *Q* channels. Following this delay line, there is an aperture compensator of a linear-phase-shift type, which provides an adjustable boost for the higher-frequency components of the signal to compensate for the finite spot size of the kinescope beams. The aperture compensator is also tied to the color killer through a relay, so that the shape of the high-boost response curve is altered automatically when the monitor is operated from monochrome signals. This automatic shift in aperture compensation further enhances the sharpness of monochrome pictures.

In the matrix section of the decoder, the *M*, *I* and *Q* signal components are cross-mixed in the proper proportions to form red, green and blue signals. The matrix circuit is a new design, requiring only one phase inverter which is highly stabilized by degeneration. The relative gains of *M*, *I* and *Q* signals entering the matrix are so thoroughly stabilized that no gain controls are required. To provide for situations where it is desired to use the monitor with a substandard signal having improper amplitude of the chrominance signal relative to the monochrome signal, a "chroma" or saturation control of limited range is provided in the form of a frequency-response trimmer on the input amplifier.

In the normal operating condition (selected by a front-panel setup switch, to be described later), this chroma control is disabled, and the monitor display may be accepted as a good indication of the actual quality of the signal applied to its input. Gain controls external to the matrix are provided for adjusting the amplitudes of the green and blue signals relative to the red. These controls are needed to compensate for component differences in the subsequent output amplifiers and for differences in the relative efficiencies of the three phosphors.

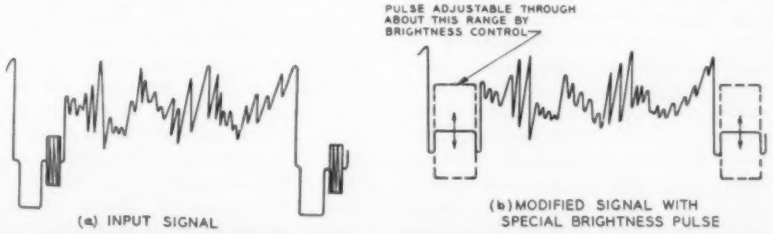
PULSE ADJUSTABLE THROUGH ABOUT THIS RANGE BY BRIGHTNESS CONTROL
(a) INPUT SIGNAL
(b) MODIFIED SIGNAL WITH SPECIAL BRIGHTNESS PULSE

Fig. 6. Waveform sketches illustrating the separation of the "Brightness" control.

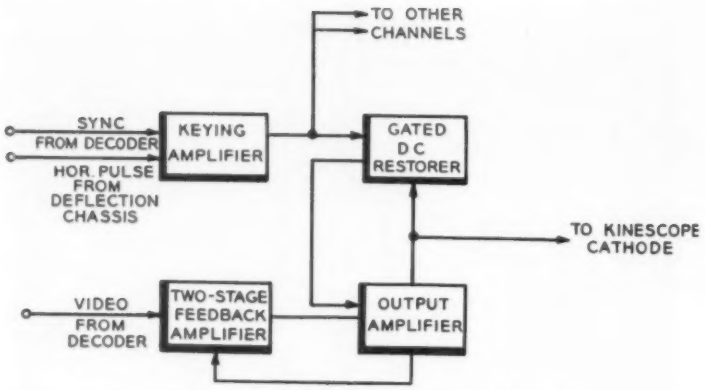

Fig. 7. Simplified block diagram of one output amplifier channel.

The decoder chassis also contains the sync separator which provides pulses for controlling the deflection circuits as well as some of the keying functions in the decoder. There is an optional input for external sync for use in situations where the monitor is operated from noncomposite signals. An interlock circuit permits remote selection of internal or external sync in applications where both composite and noncomposite signals are encountered.

Output Amplifiers

In order to maintain the proportionality of the red, green and blue signals necessary for good color fidelity, the output amplifiers used to drive the color kinescope must have excellent amplitude linearity, frequency response and gain stability. These characteristics are achieved through the use of inverse feedback as indicated by Fig. 7, which is a block diagram of one of the three nominally identical channels on the output amplifier chassis.

Exceptional black-level stability is one of the characteristics of the design.

Instead of conventional diode-type d-c restorers, the TM-21 employs gated clamps around the final amplifier stages. These achieve excellent stability by sampling for d-c conditions at the plate outputs of the final amplifier stages, but applying the correction voltages to the grids. There is this in effect, a d-c feedback loop around the final stages. The gated d-c restorers are normally operated by separated sync pulses, so that the clamping occurs during the transmission of the special brightness pulse inserted by the decoder. In the event that the sync pulses to the monitor are interrupted, control of the clamping operation is automatically taken over by horizontal pulses derived from the deflection chassis, thus preventing prolonged operation under improper bias conditions. When the monitor is operated under no-signal conditions, the brightness pulse is absent, but the monitor operates safely with a gray screen of about 20% maximum luminance.

Deflection Circuits

While the deflection circuits are based on conventional principles, they include a number of design refinements that are worth pointing out. The vertical deflection circuit is stabilized by a feedback connection between the output stage and the sawtooth generator. This arrangement not only makes the circuit highly immune to variations in supply voltages and tube characteristics, but also permits the vertical size (or height) to be adjusted over wide limits without disturbing the scanning linearity.

The horizontal deflection system is stabilized primarily by the use of a "heavy-duty" design with generous reserve factors. While typical receiver designs use a single horizontal output tube to deflect the 21-in. color kinescope, the TM-21 employs a pair of 6CD6-GA's in parallel to perform this function, and a pair of 6AU4GTA's to serve as dampers.

A unique and significant feature of the deflection chassis is an operational "size" switch for switching rapidly between a normal rounded-side picture and a reduced-size picture which permits observation of the corners. This switch operates on both the horizontal and vertical circuits simultaneously, and was made practical only by providing excellent stability and linearity in the individual deflection circuits.

High-Voltage and Protection Circuits

The high-voltage supply for the kinescope ultor is of the conventional "kick-back" type, but it is very conservatively designed to deliver all the high-voltage power that the kinescope can utilize safely (1.25 ma at 25 kv). A pair of shunt regulator tubes maintains good regulation under all operating conditions.

Because of the reserve power and signal voltages available to operate the color kinescope near the upper limits of its performance capabilities, special attention has been given to the design of protection circuits to guard against damage to the kinescope in the event of certain failures or improper operating conditions. If the beam current becomes excessive, either through improper operating voltages or as a result of excessive video drive, the bias on the kinescope grids is automatically shifted to a safe value to prevent damage to the shadow mask. In the event of horizontal deflection failure, extreme overdrive, or a short circuit in the high-voltage system, the protection circuit not only cuts off the kinescope guns but also disconnects the main +B supply on the power-supply chassis. The protection circuit itself is designed to be "fail safe," so that failure in any of its components will also protect the monitor by turning it off.

Setup Procedure

One of the highly significant characteristics of this color monitor is its ease of operation. Strictly speaking, a monitor should not be "operated" at all, because its function in a television system is to serve as a tool for an operator whose main function is to operate a camera, to check the quality of signals, or to select the proper signals for building a TV program.

On a block diagram of a complete TV system, the monitors are properly shown as appendages, not as main links in the equipment chains. It is desirable, therefore, to make a monitor so stable that its operation may be taken for granted throughout most of the working day, leaving the operators free to concentrate on their major functions. Such stability has been achieved in the TM-21, so its "operating" controls are more properly called "setup" controls. Even though the setup procedure need not be carried out very often, no effort has been spared to make the procedure as rapid and straightforward as possible.

All of the controls needed for routine setup of the monitor are mounted on the front panel, which is logically divided into three sections. The righthand side of the panel, shown in Fig. 8C, contains the deflection controls, whose functions are made obvious by clear labeling. Note that the FOCUS control is included in this section of the control panel, along with an A-C RESET button which restores the monitor to normal operation when the protection circuit trips it off. The SIZE switch, previously mentioned as a unique feature, is mounted directly under the FOCUS control.

The center section of the control panel, shown in Fig. 8B, is the convergence subassembly. Two features of the convergence circuit design which particularly facilitate a straightforward setup procedure are: (1) the controls are arranged so that the red and green rasters may be adjusted as a pair, relative to each other, after which the blue raster may be brought into registration relative to the red-green pair; and (2) every control has been made to control some type of movement in either the horizontal or ver-

Fig. 8. A, Deflection control panel; B, Close-up of convergence control panel; and C, Decoder control panel (including brightness and control).

tical direction, not along the 120° axes that prove to be quite confusing in conventional convergence arrangements.

The large number of convergence controls needed for a tricolor tube (16 in the case of the TM-21) need not seem too formidable if each of them performs some readily understood function. Those used in this monitor are so designated and arranged on the control panel that it is easy to visualize them as trimming adjustments for the deflection circuits. As shown in Fig. 8B, there are only five basic types of controls, and these are readily understood. The *position* controls are nothing more than trim adjustments for the centering function, while *size* and *linearity* carry the same connotation as in conventional deflection systems. The *tilt* and *bow* controls produce obvious effects on the lines of the grating pattern commonly used to facilitate convergence adjustments: the *bow* controls affect the curvature of the lines, while the *tilt* controls are used to make them parallel. Note that the controls are logically grouped in two ways. The *vertical*, *static* and *horizontal* adjustments are located in separate columns. The upper controls in each column adjust the red and green rasters relative to each other, while the lower controls adjust the blue raster relative to the red-green pair. A screen selector switch just to the left of the convergence control panel makes it possible to view any of the rasters separately, or to view only the red-green pair.

Figure 8A shows the lefthand section of the control panel, which contains the controls for adjusting the decoder and for setting up the kinescope for the proper color balance. It is in this section of the panel that the TM-21 differs most radically from conventional color monitor or receiver designs. Not only are there fewer controls to contend with, but also the controls are designed to facilitate an unusually straightforward setup procedure, requiring no external test apparatus other than a source of standard color-bar signals. While many of the controls shown in Fig. 8A are quite obvious, it may be helpful to describe briefly how some of them are used.

The *Brightness* control produces the same effect as conventional brightness controls, even though it operates in an unusual manner. Instead of varying the bias on the kinescope, the *Brightness* control varies the level of a special pulse added to the signal in place of the normal sync and burst signals, as described earlier. The virtue of this brightness control technique is that it eliminates the need for individual red, green and blue background controls; the single *Brightness* knob automatically exercises the proper degree of control over the three color channels because the added pulse is passed through the standard decoder matrix, and then serves as a clamping reference for the gated d-c restorers in the output amplifiers.

The *Test* switch is the key to the simplified setup procedure. By moving this switch through it several positions and making specific adjustments at each step, the monitor can be brought into proper operating condition with a minimum of difficulty. In the first position, the signal is automatically disconnected but the brightness pulse remains. In this position, the *Red Screen* control is adjusted for cutoff. The *Screen Selector* switch can be set at *R* to facilitate this adjustment by cutting off the green and blue beams to avoid confusion. In the second position, marked *Screen Balance*, both the brightness pulse and the signal are disconnected, and the green and blue screen controls may be adjusted relative to the previously set red screen to produce a gray screen of approximately 20% brightness. The *Screen Selector* switch must, of course, be in the *RGB* position for this adjustment.

In the next position, marked *Monochrome*, both the brightness pulse and the signal are applied, but the chrominance circuits are disabled. In this position, the green and blue *Gain* controls may be set to provide proper color balance in all parts of the gray scale; this adjustment is facilitated by the use of a signal containing a gray-scale pattern.

The *Unity Chroma* position of the test switch is the normal operating position, in which the signal is applied to both the monochrome and the chrominance channels. The *Chroma* control is inoperative in this position, and the saturation of the colors in the picture yields a good indication of the quality of the incoming signal. The *Phase* control may be set conveniently while in the *Unity Chroma* position by examining the blue component of a standard color-bar signal (using the *B* position of the *Screen Selector* switch). When the phase adjustment is correct, the standard color-bar signal produces four blue bars of equal brightness. If the phase adjustment is incorrect, the blue bars are of unequal brightness. This test is very sensitive, particularly if the brightness is temporarily reduced to place the blue bars near cutoff on the kinescope characteristic.

In the final position of the *Test* switch, marked *Variable Chroma*, the conditions are the same as for the *Unity Chroma* position except that the *Chroma* control is made operative. This position is intended for operation in applications where the objective of the monitor is to make the most pleasing pictures even though the signals available are slightly substandard. The *Chroma Control* is simply set for the most pleasing overall effect.

Suggested Applications

One of the most important applications for a color monitor is in control rooms where operators face the problems of setting up and matching color cameras. Because of its high quality and stability, the TM-21 is unusually well qualified for this service. The features of its design offer the following benefits:

(1) It provides a better check of registration during actual programming than the black-and-white master monitor.

(2) Because of its own excellent deflection linearity (within 1% in both directions), it provides a good check of camera deflection linearity.

(3) Its provision for underscanning to show the corners of the picture permits

better checking of camera framing, camera-lens aberrations, and camera-deflection transients. Underscanning also makes cue marks in the picture corners readily visible.

(4) Its highly stabilized method of black-level setting permits better evaluation of camera shading characteristics and the effects of camera pedestal adjustments.

(5) The precision decoder circuits and the highly linear output amplifiers yield a picture of improved color fidelity, so that camera color fidelity can be more accurately evaluated.

(6) The improved sharpness of the picture relative to other color monitors permits better results in checking camera focus.

(7) The ease of setup and the circuit stability reduce the operating cost, because very little operator time is required to keep it in operation.

(8) The excellent accessibility for servicing reduces both the maintenance cost and the "down time" in the event of tube or component failures.

Another important application for this monitor is at master-control or transmitter-monitoring points where a picture must serve as a final indicator of the quality of signals being received or transmitted. In this application, the stability of the monitor is particularly significant because it is important that operators have no uncertainty as to whether observed picture faults are due to the monitor or to the signal itself. When master-control or transmitter operators are given a monitor in which they have confidence, they can do a much better job of taking or demanding corrective action when they detect substandard signal conditions.

Another TM-21 feature of special significance in general-purpose monitoring applications is the provision for automatically removing the subcarrier trap in the monochrome channel when a monochrome picture is displayed. Most compatible color displays are limited in horizontal resolution to about 275 lines because of the necessity for attenuating the color subcarrier at 3.58 mc before it reaches the kinescope. This limitation is not serious when the monitor or receiver is producing a color picture, because the addition of color more than compensates for the loss in resolution. When producing monochrome pictures, however, a 275-line limit is quite obvious in comparison with wideband monochrome displays. This limitation has been avoided through cross-connecting the subcarrier trap with the color killer. Monochrome pictures are displayed with the full resolution capabilities of the color kinescope — about 450 monochrome pictures in many situations where it has heretofore been necessary to provide both monochrome and color monitors.

Another class of application is in "prestige" situations where it is important that pictures of the highest possible quality be presented. Both the professional appearance of the monitor and its excellent picture are definite assets in such places as clients' booths and reception rooms. Stability is important in these situations, too, because the monitor must often operate for long periods with no operator attention.

In summary, the TM-21 is a significantly new piece of equipment which its designers are confident will play an important role in the future development of compatible color television.

Acknowledgments

This development was accomplished by team effort, and no one man was fully responsible for any section of the design. It is fitting, however, that recognition be given to the individuals who made major contributions. E. E. Gloystein supervised the project and coordinated the efforts of the entire team. N. P. Kellaway did major work on the development of the deflection and convergence chassis, and guided the final design of the entire device. The decoder was developed primarily by L. J. Baun, R. A. Dischert and A. C. Luther. Other electrical engineers included F. L. Bechly, who developed the output amplifiers; and R. J. Marian, who was responsible for the power supply. The mechanical design was worked out by C. R. Morris and R. H. Schirmer.

Acknowledgment is also made to J. W. Wentworth, Manager of TV Terminal Equipment Engineering, for his support and guidance of the engineering project and his assistance in the preparation of this paper.

Discussion

Warren G. Smith (J. Walter Thompson Co.): Do you have separate R, G and B inputs on the monitor?

Mr. Kellaway: This particular model of the monitor is not designed for simultaneous operation although the decoder portion can readily be removed and an equivalent chassis could be supplied to permit simultaneous operation.

Mr. Smith: I was wondering how you could check camera operation and not also include the faults of the decoder and of the encoder?

Mr. Kellaway: An adjunct to the color camera chain is a color-bar generator whose signal, when fed to the Colorplexer (encoder) in place of a camera signal, enables one to quickly and accurately check the performance of the Colorplexer and the decoder within the color monitor. Because many of the receiver-type controls (chroma gain, I gain, IQ quadrature, etc.) have been eliminated in the monitor, the monitor cannot be misadjusted to complement a misadjusted Colorplexer. Hence, the Colorplexer must be adjusted properly to produce a balanced signal at the monitor.

Mr. Smith: Then, besides a decoded signal fed back to each control to check the operation of the cameras in the control room, we would also need a color-bar generator?

Mr. Kellaway: A single color-bar generator for each studio supplies such a signal for the whole series of Colorplexers.

Visual Amplification

By H. J. SCHLAFLY

Visual amplification is a specialized application of closed-circuit TV. It is to the sense of sight what studio amplification is to the sense of hearing. This technique, described here in detail, permits the pickup and magnified display of visual details.

VISUAL AMPLIFICATION, an electronic video technique for the visual enlargement of physical detail, is becoming increasingly popular and useful in the field of Group Communication. This paper treats the reasons for need of such a technique, the status of equipment design, and current examples of the use.

Until the development of the microphone, public gathering places were limited in size and arrangement by the natural power of the human voice. The first speech reinforcement systems met great resistance from those who were ultimately to benefit the most. Many orators considered the use of such a mechanical aid as a "crutch," a reflection on their natural or laboriously developed ability. Initial opposition, apparently a necessary step in all progress, soon passed, and the pendulum swung far in the other direction. Gathering places were built to accommodate larger crowds. Proximity to the speaker was no longer necessary in order to hear well. In fact the new medium of radio, combining sound amplification with mass distribution, completely removed the speaker from the presence of his audience.

Effect on Entertainment

In the motion-picture industry, sight without sound, a phenomenon even more unnatural than sound without sight, had passed the zenith of its popularity. The combination of large-screen motion pictures with synchronized sound amplification allowed all to see and hear in intimate detail — regardless of the size of the theater. The industry boxoffice zoomed to new heights.

But this ideal combination of large pictures with good sound did not apply to "live" presentations. Public speaking and vaudeville suffered. Increased sizes of theaters, suitable for sound motion pictures because of photographic enlargement, literally caused individual live acts to disappear. A few premium houses continued in business by filling mammoth stages with people, scenery and light or by using "radio performers" whose presentations depended primarily on the voice rather than action.

Presented on October 5, 1957, at the Society's Convention at Philadelphia by H. J. Schlafly, TelePrompTer Corp., 311 W. 43 St., New York 36.

(This paper received in final form Feb. 18, 1958.)

Public Speaking

Public speaking, except via the radio, survived primarily as an amateur rather than as a professional medium. The loss of effectiveness through neglect of visual presentation was ignored for many years. Today there is a resurgence of public speaking in the form of a new technique called Group Communication. Group Communication is the art of transferring thoughts from one individual or group of individuals to another group of individuals. To accomplish this end, one makes use of any "tools" that are technically available to help solve the human problem — the problem of capturing and keeping an individual's attention to such a degree that he can *absorb* and *retain* the thoughts the speaker wishes to transfer. Industry is currently spending over 300 million dollars annually in the meeting and public speaking field because efforts at Group Communication are being made more and more effective through a return of the principles of showmanship.

Showmanship is live, dynamic presence; it is personality and expression. Showmanship is a combination of artistry, human understanding, and precise timing. Showmanship is the correct and unobtrusive use of those technical aids which allow an audience to hear what the speaker wants to say and to see what the speaker wants to show.

Visual Presentations

Effective visual presentations are vital to showmanship for they supply information or permit an understanding of information in a manner far better than that of the speaker's voice alone. They permit simultaneous presentation or reinforcement of thoughts instead of the sequential stimulation which is one limitation of language.

One of the visual aid tools most recently added to the Group Communication field is closed-circuit television. This relatively new medium must be defined with some care; it can mean many different things to many different people. To some, closed-circuit television means monitoring the numbers on freight cars out in the switching yard or surveillance of shoppers in a department store; to others, it is a championship fight viewed on a theater-size screen or "coin-in-the-slot" entertainment at home; still others think of it as a means of education in a school or detailed observation of an operation in a hospital.

In the world of business meetings, closed-circuit television is most generally a substitution of modern communication for transportation. The electronic problem of visually and audibly presenting a top management sales team simultaneously and instantaneously to a large number of audiences in widely separated locations is far less costly in time and money and more effective in results than the physical problem of transporting, lodging, feeding and entertaining a similar audience for the same meeting at some "central location."

Visual Amplification

Visual Amplification is simply a specialized use of closed-circuit equipment where both camera and viewing screen are operated in the same room. This technique restores the balance between audience sight and sound which was lost during the exclusive era of the microphone. Specifically, it is the electronic enlargement of physical detail to implement group viewing. The camera has joined the microphone in becoming a privileged personal agent for each individual in the audience. Through Visual Amplification, minute detail can be shown on a screen whose size and position is selected for the most comfortable viewing. Now everyone is brought close enough to the speaker to see his facial expressions and to be visually persuaded by his enthusiasm and his sincerity. In effect, each person has a front-row seat to watch operation of the new product, to inspect the new sales feature, and to evaluate the nature of the problem under discussion.

Technical Problems

There are technical problems, of course. Today's meeting rooms do not have and are not yet expected to have the equipment facilities, the personnel or the space of a studio. Lighting of the subject and positioning of the viewing screen are critical to avoid the problem of spill light. There will be some cases — perhaps many cases — where Visual Amplification cannot now be conveniently used. With increasing popularity there is no doubt that equipment and operating techniques will be improved and refined to accommodate the needs of this specialized application. It does not require an overstimulated imagination to predict that Visual Amplification in a meeting room may soon be a routine facility, no more involved and possibly little more expensive than a good sound amplification system.

Current Use

The fact remains, however, that Visual Amplification is being used now. At the Homestead in Hot Springs, members of the last ANA Convention watched a speaker walk to an involved piece of equipment which he wished to describe. Center stage, on a 9 by 12-ft screen, the audience was able to follow each movement of his hand as he operated the device. In Las Vegas, and later in Reno, comedian Peter Lind Hayes used Visual Amplification in his nightclub act. In Boston, the Liberty Mutual Insurance Company easily solved an "impossible" problem of showing details of an effect in a ripple tank — without one member of the audience having to leave his seat.

Conclusion

Technical progress is restoring balance between sight and sound in the field of Group Communication by the addition of Visual Amplification as one of the visual aid tools. The technique is just now emerging into popular use. Progress in this field can be greatly aided by imaginative people who contribute to refinement of Visual Amplification techniques and by imaginative development of television pickup and projection equipment for greater simplicity, reliability and quality. The objective is implementation of communication of thoughts, ideas and information in a manner which permits better understanding, retention and comfort with less confusion and lost time.

Survey of Large-Screen Television Projection Equipment

By FRANK N. GILLETTE

The large-screen equipment available to the industry in the period around 1950 was described to the Society in a number of different papers. Since that period certain changes have taken place in the equipment, but these changes have passed generally unnoticed because of the relatively dormant state of the closed-circuit field. A survey of the equipment now used in this very active field is presented.

THIS PAPER discusses the various types of equipment which are available at the present time classifying them not on the basis of manufacturer or model number but rather on the basis of certain readily observable construction features.

Because the quality delivered by a television projector is the net result of a great many factors, it must be realized that not all units which can be placed in the same classification will deliver equal performance. In each case the performance which is described is believed to be the best that can be expected of equipment in the class concerned.

The general class of equipment to be considered is black-and-white television projection equipment using a single picture tube and designed for a picture at least 8 ft wide.

Measurement of Light Output

Before considering specific apparatus it is desirable to state the basis of comparison — not only the qualities that are important but also the methods by which they are measured or otherwise evaluated.

Undoubtedly the most important single characteristic of a television projector is the amount of light it will deliver to the projection screen. A numerical statement of light output will be most useful if it is based on a method of measurement which is easily reproduced and if it can be used to predict projection performance under any given condition.

A quantity that has been named "equivalent highlight lumens" seems to meet these conditions very well. It amounts to the number of lumens that would be delivered if the entire picture had the brightness of the brightest highlight.

It can be measured on any test scene that is predominantly black or dark gray and contains a highlight of high brightness and small area. With the projector adjusted to set the highlight as high as possible without loss of detail in the highlight or excessive defocusing, the illumination level in the highlight is measured in foot-candles. The highlight illumination multiplied by the picture area in square feet gives equivalent highlight lumens.

It will be recognized immediately that this figure is completely hypothetical. Television projectors as now constructed cannot possibly produce a picture that is all highlight. Overload of the cathode-ray tube, power supply or both would certainly result if it were tried. However, the figure is nonetheless quite useful in that it is comparable to the light-output figures conventionally presented for motion-picture projectors. It would be exactly comparable if motion-picture practices called for measurement of light output with film of minimum density in the gate.

Given the equivalent highlight lumen figure of a television projector, one can compute quite readily the brightness that will be observed from any point in the audience under any particular projection circumstance. It is, of course, necessary to have the dimensions of the projected picture and the reflection characteristics of the screen to make this computation, but these figures are generally readily available.

Resolution

Another essential characteristic of a television projection unit is the resolution. This quantity is measured by the familiar RETMA (EIA) chart method which results in values for horizontal and vertical resolution stated in terms of lines per picture height. The numbers measure the limiting resolution of the system. Despite the shortcomings of limiting resolution as a system specification, it is still universally used because no other quantity can be measured so easily.

In any practical projection situation the television standards impose the limitation of some 350 lines vertical resolution and some 320 lines horizontal resolution. However, the television standards in an ideal system would give perfect response for any line number up to these limits. The real components used, particularly the cathode-ray tubes and the projection optics, do not possess these ideal characteristics. They begin to cause some deterioration of the signal even at the lowest line numbers. If reasonably good response is to be retained out to the 350-line region, the limiting resolution of the projection elements must be pushed far beyond that point.

Presented on October 8, 1957, at the Society's Convention at Philadelphia by Frank N. Gillette, General Precision Laboratory Inc., 63 Bedford Rd., Pleasantville, N.Y.
(This paper was received on November 1, 1957.)

The benefit of so doing will be principally evident to the viewer in its effect on the next important system characteristic, namely, the contrast.

Contrast

The contrast observed in the projected picture is a highly important factor in the subjective evaluation of picture quality. It is seldom if ever measured and is indeed in many instances not even considered as a variable, but its effect is always present in the subjective judgment.

The system starts with a sharply limited contrast range at the face of the cathode-ray tube as it exists within the optical system. Light spreads in the phosphor, reflects back from the outer surface of the faceplate and reflects back from the mirror and even the projection screen.

The net effect, if the system is operated so as to avoid saturated whites or cropped blacks, is a contrast ratio at the tube never more than 30 to 1, usually less than 20 to 1 and often worse than 10 to 1. Perhaps this statement can be made more pointed by observing that the blacks on a projection tube commonly have measured brightness roughly equal to the brightness of the surface of a fluorescent lamp.

Additional losses in contrast, particularly in areas of fine detail, are caused by the shape of the scanning spot of the cathode-ray tube and the residual aberration of the projection optics. These factors produce a measurable loss in detail contrast, but they produce an effect on subjective impression of contrast far greater than the measured differences would indicate.

Any aberration of optics or tube will impose some limitation on picture sharpness. This effect may be too small to change limiting resolution as measured in any field test, but an effect on picture sharpness will always be present. As was demonstrated very effectively by Ralph Evans at a recent SMPTE convention,* an observer's judgment of contrast will be drastically influenced by picture sharpness. So long as the projected television pictures are sharp the observer does not realize how limited is the contrast of the picture. If sharpness is lost the poor contrast becomes immediately evident. Contrast will also be reduced by ambient light, but since this is not a characteristic of the equipment it can hardly be used as a basis of comparison.

Background

The years just before and after 1950 were a period in which theater television was believed to be making the first steps in a growth pattern that should have made it a healthy giant by this time. The concept of the day called for the best possible equipment permanently installed in each theater worthy of preservation. The better units designed in that period were cumbersome and heavy, but did a very good job. They are evaluated below under the class name "7NP4."

In the period around 1950 some attempts were made to do the theater job with smaller systems (described below in the "5TP4" group) which generally proved inadequate for that task. As the pattern changed from the theater television idea to the tele-session approach, the emphasis shifted solidly to portable equipment. This type of equipment has gone through several steps of evolution, divided in the following paragraphs into "5AZP4," "5AZP4 Plus Blower" and "12-in. Corrector Plate" classes. It will be obvious that the various class names have been arbitrarily assigned simply to serve as identifying labels.

7NP4

The systems using the 7NP4 were originally planned for permanent installation in specially prepared locations. Some of these units have since been made more readily mobile, but they can still hardly be called portable.

The 7NP4 operates at an accelerating potential of 80 kv and an average beam current of 2 ma. It is used with adaptations of the Schmidt optical system containing mirrors of around 26-in. diameter and corrector plates of about 23-in. diameter. These units deliver about 900 equivalent highlight lumens.

The cathode-ray tube and optics will resolve more than 1200 lines. For one type at least the system as a whole including the video section is good for about 800 lines. The contrast is good even in the corners and excellent in the center. This equipment was high in both initial cost and operating expense, the latter because of the high replacement cost of the 7NP4 tube.

5TP4

The 5TP4 was initially applied to home receivers. In this use it worked well, but when it and in some cases its associated optics were diverted to large-screen use the result was not so good. The tube was limited to operation at 27 kv and some 200 μa.

With Schmidt mirrors of either 12-in. or 14-in. diameter and corrector plates of $8\frac{1}{4}$ in. diameter, a system might produce 25 to 30 equivalent highlight lumens.

Near the maximum current rating, beam focus was not very good, limiting resolution quite severely. These systems would do about 500 lines in the center with fair contrast and about 450 lines in the corners with poor contrast.

5AZP4

A marked improvement in the small projectors took place with the introduction of the 5AZP4. It operates up to 40 kv and 200 μa. The higher voltage improves both light output and resolution, the latter being evident mostly in the form of improved contrast.

These units provide about 50 equivalent highlight lumens and are good for about 600 lines in the center with fair to good contrast, and 450 lines in the corner with fair contrast.

5AZP4 Plus Blower

The beam-current limitation in the 5AZP4 is found in the phosphor of the tube. If it is hit with too much energy it becomes overheated and a peculiar spread of light within the phosphor occurs. The provision of an air stream directed against the faceplate of the tube provides sufficient cooling to approximately double the energy that can be dissipated by the phosphor before it saturates.

Systems which include the blower furnish about 100 equivalent highlight lumens with performance otherwise changed very little.

12-in. Corrector Plate

The three 5-in. systems thus far described use optics different in detail, but quite similar in general. Some are of glass, some of plastic, but all have roughly the same performance capability. The continuing demand for more light has forced the development of optics of larger aperture. The largest of these thus far reported is one with a corrector plate of 12-in. diameter.

Such a system has a geometric aperture of perhaps $f/0.6$. To achieve this

Table I.

Equipment class	Approximate light output in equiv. highlight lm	Resolution		Detail contrast	
		Center	Corner	Center	Corner
7NP4	900	800	600	excellent	good
5TP4	30	500	450	fair	poor
5AZP4	50	600	450	fair/good	fair
5AZP4 Plus Blower	100	600	450	fair/good	fair
12-in. Corrector Plate	200	600	300	good	fair

* Illustrated lecture, "Sharpness and Contrast in Projected Pictures," October 11, 1956, Los Angeles.

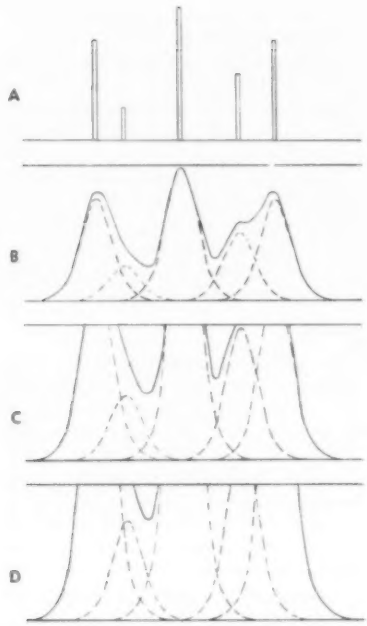

Fig. 1 Brightness distribution represented by the familiar bell-shaped curves.

aperture without loss of image sharpness somewhere in the picture is probably impossible; however, surprisingly good jobs have been done. The problems are not in design alone, but also appear in manufacture. For this reason different equipment types in this class will show even greater performance differences than would be expected with the preceding classes.

Simple calculation would indicate these systems should have nearly three times the light output of preceding systems. However, other limitations exist such as mirror diameter or the way in which the cathode-ray tube fills the system aperture. The observed result is an output of about 200 equivalent high-light lumens. The resolution is 600 lines in the center with good contrast, and 300 lines in the corner with fair contrast.

Summary

Anyone familiar with the varieties of television projection equipment that have been crammed into these five classes (summarized in Table I) will realize that attention has been focused on similarities while differences have been resolutely ignored. Nonetheless, the differences are there and will account for very large variations in performance. Even within a single type made by the same manufacturer distinguishable differences will be found. In view of these differences, assignment of any numerical values has been difficult and for this reason the preceding statements have not been more explicit.

Discussion

Glenn E. Matthews (Eastman Kodak Co).: You spoke of a peculiar change in focus when phosphor saturation is reached. If you could give a further explanation of the mechanism involved, that would be of interest.

Mr. Gillette — by mail: The peculiar things that happen to an image at phosphor saturation can be explained to a large extent simply by considering the nature of an image and the effect of saturation on its elements. An image, either optical or electronic, is the total effect produced by many image points. Each point has a brightness distribution that can be represented by the familiar bell-shaped error curve.

A group of bright image points, such as those shown in Fig. 1, curve A, will be reproduced as shown in curve B. The dotted curves show the contribution of each point and the solid curve shows the observed composite brightness. The width of each dotted curve is determined by the system bandwidth, the sharpness of scanning spots, etc. The height is determined by original brightness, system gain and so on.

In curve B the horizontal line representing saturation level lies above the peak brightness and the spots are reproduced with the maximum resolution of which the system is capable. Increasing system gain produces curve C and causes some image elements to reach saturation and flatten off. At still higher gain much more of the image saturates as in D. The broadening of image and the loss of detail are quite obvious.

Visualizing this effect applied on an area basis one can readily believe that saturation alone can be highly destructive of image quality. Probably the effect seems strange because optical or photographic systems do not contain elements which saturate in the sharp fashion of a cathode-ray-tube phosphor.

Medium Screen Color Television Projection

By S. L. BENDELL
and W. J. NEELY

Closed-circuit television has created a need for picture display equipment suitable for large groups. Basic engineering and economic factors influencing the design and use of such equipment are discussed. The wide variety of applications for such a unit dictates that special emphasis be put on compactness, mobility and easy operation. These requirements have resulted in the design of a small inexpensive TV projector suitable for color or monochrome. Its operational features are described.

As TIME goes on, television occupies a position of increasing importance in the cultural, educational and industrial phases of our lives. The television receiver in the living room has reshaped the very texture of our society. When the full potentialities of television for purposes other than home entertainment are realized, these new applications will assume an even greater place in our everday lives. It takes little imagination to envision the possibilities of television in our educational institutions. To those of us who have had a part in the growth of the art, the successful use of television for the teaching of surgery has been most gratifying. Sales meetings, conventions and training sessions may soon be powerfully augmented by the use of closed-circuit television. It is certain that in many cases the television picture will be observed by large groups of persons, as contrasted to the few that at present gather around the screen of the home television set. Projection television offers the most practical method of displaying a picture large enough to meet the requirements of an audience anticipated in the use of closed-circuit television. This discussion is concerned mainly with considerations of color television projection for audiences ranging from 50 to 500 persons.

Presented on October 8, 1957, at the Society's Convention at Philadelphia by S. L. Bendell and W. J. Neely (who read the paper), Bldg. 10–3, Commercial Electronic Products, Radio Corp. of America, Camden 2, N.J.
(This paper was received on November 25, 1957.)

Basic Considerations

In viewing a color television picture, there are maximum and minimum viewing distances which must be considered. To prevent elemental picture structure, scanning lines, grain, etc., from being distracting, it is customary to restrict the minimum viewing distance to no less than two picture diagonals. The maximum viewing distance has, through experience, been determined

Fig. 1. TLS-50 Projector, showing Schmidt optics assembly.

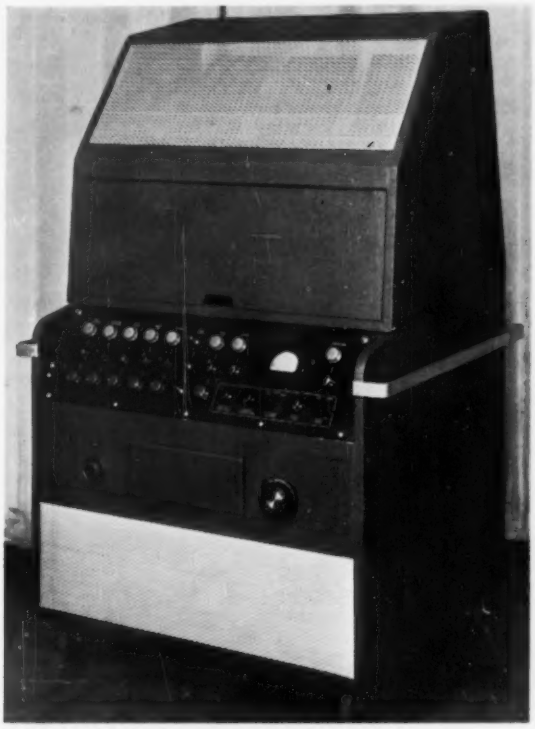

Fig. 2. TLS-50 Projector, control position view.

as no greater than eight picture diagonals. At viewing distances greater than this it becomes troublesome for the viewer to resolve fine detail. Another restriction on viewing position is the matter of angle. Rather arbitrarily, perhaps, the authors hold that the total horizontal audience angle should not greatly exceed 60 degrees.

From the above discussion it follows that the audience size should determine the auditorium size and the geometry of the auditorium should, in turn, be the final factor in setting the picture size. It is wasteful, for example, to put a 9 by 12-ft picture into a room 20 ft square for viewing by 25 persons. A 6 by 8-ft picture will do nicely for a room having a depth of 80 ft and a width of, say, 60 ft. Such a room will comfortably seat 500 persons, obeying the restrictions on maximum viewing angle and minimum and maximum viewing distances.

How *bright* a projected picture *can* be is of little interest at the present state of the television projection art. Rather, it is important to consider how *dim* it can be and still fill certain basic requirements. Absolute figures for picture brightness are quite meaningless unless one defines a complete set of psychophysical factors, which, too often, are overlooked. When the eye is completely dark-adapted, numbers designating picture brightness can be misleading. Since every auditorium has, through necessity, some stray ambient light, it becomes important to consider picture brightness requirements as they are affected by adaptation level of the eye and the ambient light in the auditorium, especially that portion which falls on the screen.

The ambient light falling on the screen obviously sets the brightness level for the *blackest* portion of the projected picture. The projected picture contrast-ratio required to present a pleasing display to the viewer when multiplied by the ambient light reflected from the screen gives the picture highlight brightness. Significantly enough, this value of highlight picture brightness is determined by a ratio rather than a figure of absolute light level. Lower levels of ambient light (reflected from the screen) mean that lower values of picture highlight brightness will be acceptable.

There are, however, practical lower limits to the ambient light levels in an auditorium. Too low an ambient light level may make it difficult for the viewer to perform simple tasks such as seat-changing and note-taking. Also, the length of time required for the eye to dark-adapt to the surroundings may become excessive and thus make it difficult to integrate a television sequence into the normal auditorium program. In the complete absence of ambient light, too low a value of highlight brightness will lower visual acuity and cause viewer fatigue. In view of all of these factors it is felt that the minimum picture highlight brightness should not be less than 1.0 ft-L. For projected picture contrast ratios of 15 to 1, this implies that the stray light on the screen should reflect less than 0.06 ft-L to the audience. By judicious use of directed audience lighting, the available ambient light for note-taking, etc., can be made several times this value.

Many of the uses for large-screen television projection require that the equipment be light, and capable of fast setup by one man. The equipment cost factor cannot be overlooked — nor can the fact that the single television projector is competing with multiple receiver installations. To obtain bigger, brighter pictures at this state of the art is possible, but the cost increases more rapidly than picture size and makes very large pictures unattractive economically.

Picture Size

In order to produce a picture of specified brightness, the direct relationship between screen size and kinescope size must be recognized clearly. If we use straightforward Schmidt optical systems having typical speeds of the order of *f*/0.7, the area of the kinescope is directly proportional to the area of the final picture. The kinescope power (second anode voltage times beam current) is also directly proportional, assuming all phosphors are being excited with the same power (w/sq cm).

Increasing the kinescope size and power to gain picture size means that the optical barrel diameter increases in the same direct proportion to maintain the

$f/0.7$ optical speed. For example, a 2.5-in. projection tube would have a barrel 8 in. in diameter while a 7.0-in. tube would require a 22-in. barrel. These comparisons immediately indicate the relative equipment sizes for different picture display sizes.

Picture Brightness

Practical values of brightness which can be obtained economically fall in the range of 0.5 to 2.0 ft-L (nondirectional screen). A straightforward method of increasing screen brightness for a given size of picture is to increase kinescope size and second anode power. For example, in order to double the screen brightness one would have to double the kinescope face area, double the anode power and increase the diameter of the optical barrel by 40%. It is generally found that equipment cost and size increase more rapidly than does the psychological impression of picture brightness.

In discussing second anode power requirements it was assumed that the power (w/sq cm) required to drive the phosphor for greatest light output is constant. Increasing the power into a phosphor raises its temperature and reduces its efficiency until the point is reached where further power produces no further increase in light. This is termed phosphor saturation. Cooling the kinescope by forced air is helpful but it is not fully effective because the glass insulates the phosphor and because dust and moisture deposits may increase. In cases where it is used, the purpose is mainly to prevent the glass envelope from cracking.

The use of higher anode voltages, necessitated by using tubes of larger diameter, leads to x-ray browning of the glass. Special glasses are available to minimize the browning, but their use increases the cost of kinescopes.

The phosphor efficiency factor is a function of the hue of the light output. The red tube used in projection television is usually the least efficient of all the phosphors and therefore sets the maximum brightness limit of the final color-balanced picture. With present techniques it has been found most practical to use an orange phosphor and correct the color by using a red optical filter. The blue and green phosphors are so compounded that their spectral characteristics meet the colorimetric requirements of the NTSC color primaries directly.

Directive screens are a relatively inexpensive way of gaining picture brightness. Lenticulated screens having gains as high as 4.0, and sufficiently wide horizontal angles, are available and have been used successfully. In color television projection where the three optical barrels are oriented so that they are not on a common axis, some precaution is necessary to eliminate color balance variations as a function of viewing angle; that is, the gain of the screen must be fairly constant with angle in the audience seating area.

Throw Distance

Since the rear of an "average" auditorium is indeterminate, and since it is undesirable to locate projector and operator in the center of the audience, it is evident that the most logical placement is in the front row center of the auditorium. An advantage of this location is that the throw distance is short. This reduces to a minimum the optical barrel diameter for a given "f" number. To operate with such a short throw distance, it becomes necessary to tilt the screen vertically, in order to preserve definition over the whole area of the picture. The shallow depth of focus of the high-speed Schmidt optics requires that the screen be perpendicular to the optical axis of the projector. The screen height is determined by the requirements for unobstructed viewing for persons in the rear of the auditorium. The projector height should be limited to allow unobstructed viewing for persons in the front of the auditorium immediately behind the projector.

Description of a Projector Meeting These Requirements

After consideration of all of the above physical problems and cost factors, a program was undertaken by RCA to design a projector suitable for audiences of 50 to 500 persons. This size of unit was chosen since it is believed it best meets the present and near future requirements of closed-circuit television. Such a projector is shown in Figs. 1 and 2.

Some of the features of RCA's telemural projector are:

(1) Throw distance is from 8.5 ft to 17 ft, a function of picture size.

(2) Color picture highlight brightness varies from 4 ft-L at a 3 by 4-ft size to 1 ft-L at a 6 by 8-ft size, using a screen with a gain of 2.5.

(3) Monochrome picture highlight brightness varies from 10 ft-L at a 3 by 4-ft size to 2.5 ft-L at a 6 by 8-ft size, when using a screen with a gain of 2.5. In this case, the color kinescopes are replaced by monochrome kinescopes.

(4) Simplified Philips Schmidt optics in an off-axis horizontal array and controls for electronic correction of geometric distortion are used.

(5) All electronic and mechanical setup and operating controls are available to the operator seated on the audience side of the equipment.

(6) Registration is very stable and is accomplished by mechanical centering. Electronic size and linearity controls are used for raster matching.

(7) The triode-gun kinescopes permit good resolution at high beam currents.

(8) Individual d-c controls on each kinescope grid and cathode make white balance possible throughout the complete luminance range.

(9) Metering circuits provide the necessary instrumentation for optimum performance.

(10) Hinged covers give protection for optics and control settings during periods of standby or storage.

(11) Operation from line-video or RF feed is possible.

(12) The weight is less than 300 lb. The dimensions are: 54 in. high, 30 in. wide, and 29 in. deep.

(13) Total power consumption is less than 550 w.

Conclusion

Some of the basic factors influencing the design of a television projector have been discussed and it has been shown how they led to the logical development of a commercial unit. Our initial assumption that the most immediate need was for a unit suitable for medium-sized audiences has been confirmed by our field experience since this equipment was introduced a year ago. Excellent results have been obtained both in fixed closed-circuit color applications and in mobile demonstrations where the equipment is set up quickly, used, and moved to a new location.

A Means of Preventing the Formation of Newton's Rings During Contact Printing of Motion-Picture Film

By CHARLES E. OSBORNE

Certain film structure and processing conditions may result in smooth-surfaced processed negatives and intermediate films which cause Newton's rings when contact printed to smooth-surfaced print films. An application of a fine, evenly dispersed spray of a commercially available printers' nonoffset solution to such a film, before printing, effectively prevents these printing defects. The equipment and method of application are described.

When two very smooth surfaces are placed in intimate contact, so close that the distance between them is of the order of the wavelength of light, the familiar optical interference pattern known as Newton's rings is often formed. This pattern, so frequently seen on an oil-slick or soap bubble, results from alternate interference and reinforcement of light of various wavelengths, depending on the relationship of the distance between the two surfaces and the wavelength of the light.

If, for example, these bands are formed between film surfaces or between film and glass surfaces in an enlarger, a photographic image of these rings, as well as of the desired picture, will be formed. In the example shown in Fig. 1, the necessary degree of smooth contact was obtained between the smooth-surfaced film base and the glass of the negative carrier of the enlarger.

Newton's rings in a still picture are recognizable as such because of the successive bands or fringes of color. In a motion-picture print, however, each frame results from a separate contact-printing operation of separate areas of negative and print stock. It would only be under unique circumstances that each of the rings would form in the same relative position in successive frames. Therefore, each successive frame usually has both different degrees and different locations for its Newton's rings, and the images on the motion-picture screen may appear, not as distinct contours of alternating color bands, but as a nonuniformity (if the rings appear and disappear in successive frames), a mottle, or a streak. Only an experienced observer would identify these as ring interference patterns.

It is only in special cases that distinct recognizable motion-picture images, owing to Newton's rings, appear on the screen. This may happen when the pressure pad at the gate of a contact step printer has a distinct point of pressure, which maintains close contact repeatedly at one well-defined point. Similarly, if a negative has a relief image in combination with an otherwise smooth surface, a high area in this relief image may provide a constant location of close contact between negative and print stock, and thus maintain the shape and location of ring pattern over several frames so that the eye may recognize this image in the motion-picture print.

The conditions of intimate contact between two smooth surfaces may often exist in motion-picture contact-printing operations. The surface of a release-print raw stock is usually smooth and the surface of a negative or a duplicate negative may also be smooth. A lacquered negative, for example, may have a very smooth surface. An example of the effect of lacquering is shown in Fig. 2. Light at grazing incidence was used in

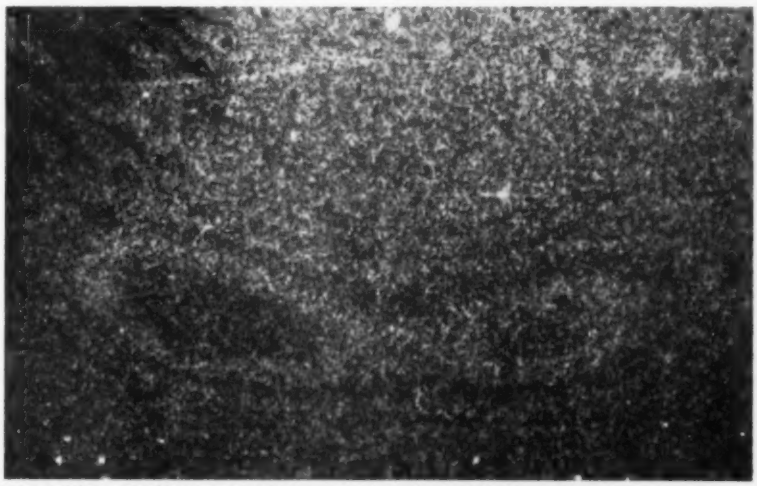

Fig. 1. Photographic image of Newton's rings (magnification 100×).

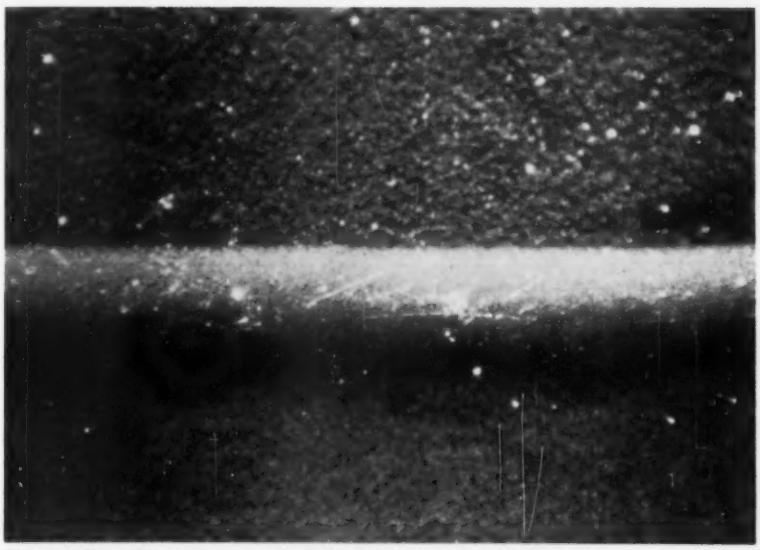

Fig. 2. Effect of lacquer on a rough surface (magnification 100×).

Communication No. 1937 from the Kodak Research Laboratories, presented on May 1, 1957, at the Society's Convention at Washington, D.C., by Charles E. Osborne, Research Laboratories, Eastman Kodak Company, Rochester 4, N.Y. (This paper was received on December 21, 1957.)

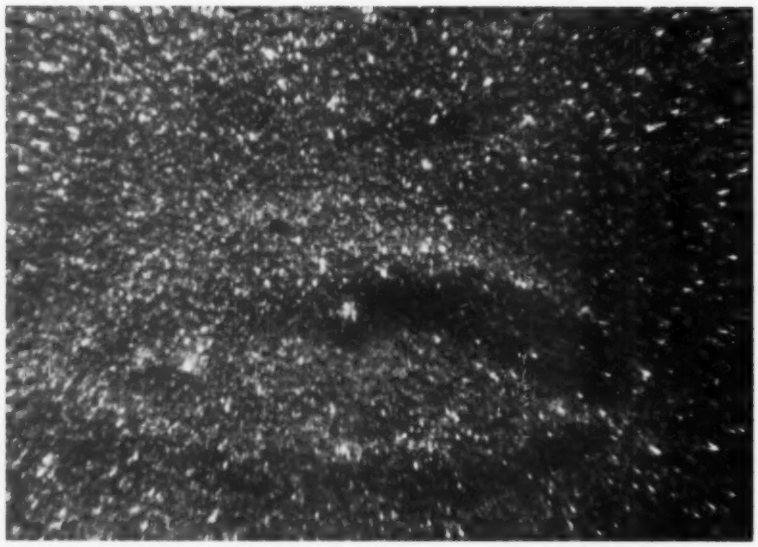

Fig. 3. Surface area of a dichromate-bleached color negative (magnification 100×).

photographing this area to bring out any surface roughness. In this illustration, the area at the top of the picture has not been lacquered; the area at the bottom of the picture is covered with lacquer. The ridge of the edge of the lacquer runs across the middle of the picture.

In addition to smooth surfaces, the other necessary condition for Newton-ring formation, namely, close contact between surfaces, may exist. In contact-printing, extremely close contact is a necessity if good image sharpness and freedom from color fringes are to be attained. Several methods are used to attain the desired degree of contact between negative and print stock. In step printers, vacuum gates or pressure plates are used. In continuous printers, pressure shoes or air pressure from either the negative or positive side of the aperture forces the films together at the printing aperture. Whatever the method, if the contact is adequate to produce good image sharpness, it may also be adequate to produce Newton's rings between a smooth-surfaced negative and print stock. In fact, one test of good contact in the printer gate is the formation of Newton's rings between two smooth film surfaces.

Good contact, therefore, a necessary condition for Newton's rings, is also a necessary condition for good print sharpness. Smooth surfaces, however, are not always present. Eastman Color Negative Film, Type 5248, for example, processed as recommended, with a dichromate bleach which tans the gelatin as it bleaches, has a relief image and rough surface (Fig. 3). The rough surface is actually the result of local relief images of groups of grains in the surface layer. Figure 3 is a photomicrograph of a negative of a human eye enlarged about 100 times. Such a film is rough enough to prevent formation of Newton's rings, regardless of the surface of the print stock.

When Eastman Color Negative Film, Type 5248, is processed so that no relief image is formed, the surface roughness is greatly minimized, as shown in Fig. 4, which was made under the same conditions as Fig. 3. Only accidental and unwanted dust specks on such a surface would prevent close contact with a smooth-surfaced print stock in a good contact printer.

Processing recommendations for the newly introduced Eastman Color Intermediate Film, Type 5253, call for a bleach solution which produces a smooth surface on the processed film.* This makes it desirable to use a specific method of preventing the formation of Newton's rings in contact-printing operations. It is possible to apply to the surface of the processed film particles of materials which will be large enough to prevent intimate contact during printing, and yet small enough so that they will not show in reproduction. This provides a suitable solution to the problem, especially if the particles can be removed safely from the processed film when necessary.

The spray application of an aqueous suspension of fine particles to the dry surface of a negative or a duplicate negative has proved to be a satisfactory method. The simple equipment used in the tests is shown in Fig. 5. The negative is carried at a constant speed (42 ft/min) through an area in which a very fine spray of American Type Founders Non-Offset Mix No. 109 is directed from a controlled spray gun to the emulsion surface. The 3-ft extension arm at the right provides the necessary drying time at 40% relative humidity and at 75 F before the take-up reel. A rubber drive roller just before the take-up reel provides the constant-speed transport. Not shown, but necessary in continuous operation, is a spray booth or exhaust system for the area where the apparatus is to be used. This system is an essential feature of the apparatus, as it greatly reduces the dust hazard from the dried particles which are not deposited on the film.

The controlled spray is provided by a Model H Paasch 3-in-1 Air Brush, shown in Fig. 6, and equipped with a Type III "color-adjusting part." Oil-free compressed air, regulated at 25 psi by a pressure-control valve, is supplied to the airbrush to atomize the Non-Offset Mix. Spray-particle size is determined by the type and adjustment of the needle valve of the airbrush. The amount of spray is controlled by the air-pressure setting. The Type III needle valve has been found to provide the desired par-

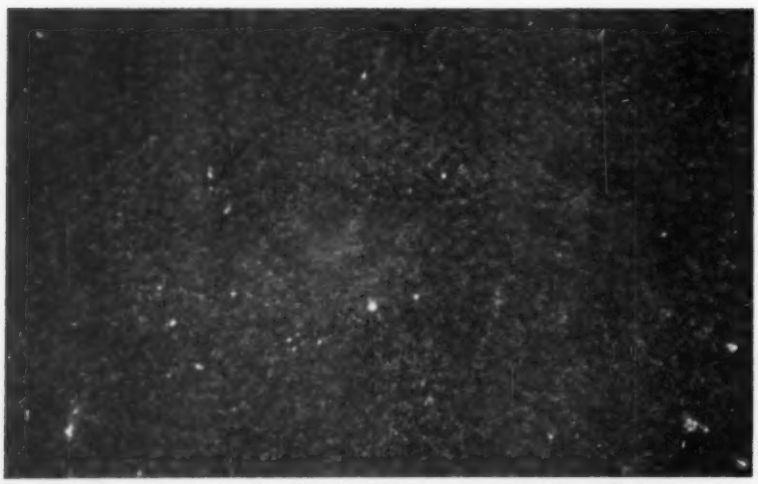

Fig. 4. Surface area of a ferricyanide-bleached color negative (magnification 100×).

* H. J. Bello, Jr., N. H. Groet, W. T. Hanson, Jr., C. E. Osborne and D. M. Zwick, *Jour. SMPTE, 66:* 205–209, Apr. 1957.

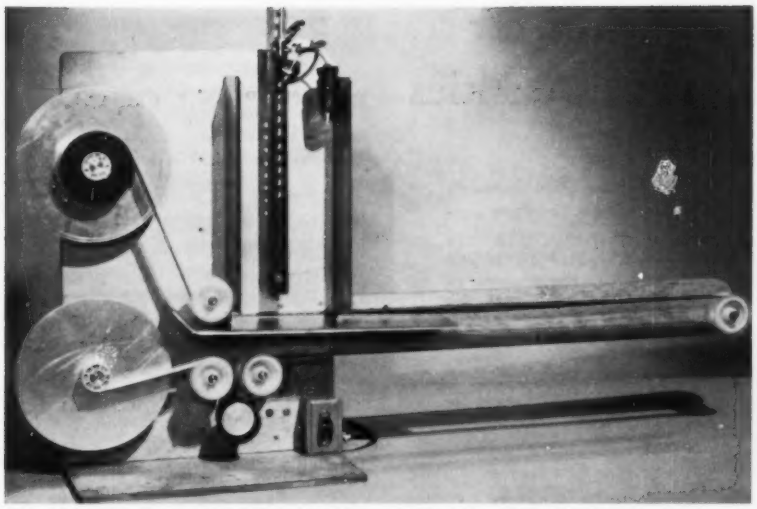

Fig. 5. Film-transport drive showing the position of the airbrush.

ticle size, and with 25 psi air pressure, only 10 to 12 ml per hour of the Non-Offset Mix is atomized. When the film is carried about 14 in. below the spray gun, under these conditions, an adequate and consistent quantity of fine particles of the desired size can be deposited on the film surface.

A 100×-diameter enlargement (Fig. 7) shows the surface of film treated in this manner. The dried-particle spray may be seen as transparent globules attached to the surface. The film area shown in the picture is about $\frac{1}{32}$ of an inch in diameter, and illustrates how few particles are needed. It is difficult to specify the exact conditions for predetermining and controlling the particle size and distribution, but experience has shown a fairly wide tolerance in the quantity and quality of particles needed to prevent the formation of Newton's rings without being objectionable for other reasons.

A test negative sprayed in this manner has maintained its protection from Newton's rings after 100 passes in a continuous contact printer. How such protection would hold up after film-cleaning treatment would have to be determined for the particular treatment used. Simple wiping, for example, will not remove the particles, but some solvents may, and water washes definitely will remove all particles. After such water washing, respraying is a necessity if protection is to be maintained.

For certain operations, the removal of the particles by a simple water wash may be advantageous. Usually, particles large enough to prevent Newton's rings can print as objectionable images if the printing is very specular. In some optical printing operations, where very specular illumination is used, and where a sprayed negative is to be printed, the negative can be washed to remove all particles before printing.

A variation of this spraying procedure is useful in operations where the major use of a negative is in optical printing but where only an occasional contact print, such as a daily "rush" print, is required. In this case, the print-film raw stock can be sprayed, under proper safelight conditions, of course, before the printing operation. The print stock then has a rough surface which will prevent the occurrence of Newton's rings, and special treatment of the negative is avoided. The spray particles are removed from the print stock during processing.

The information herein is furnished without any warranty or guarantee whatsoever; e.g. with regard to operation, safety, results or patent infringement and nothing herein shall be considered as a recommendation or inducement to infringe patents of others.

Fig. 6. Paasch Model H 3-in-1 Air Brush.

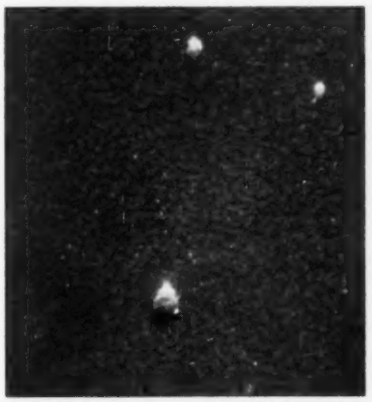

Fig. 7. Enlargement (100×) showing particles of American Type Founders Non-Offset Mix No. 109 deposited on a smooth-surfaced negative.

A Silver-Recovery Apparatus for Operation at High Current Densities

By NICHOLAS J. CEDRONE

Silver recovery systems operating at the higher current densities require thorough solution agitation at the cathode surface in order to deposit metallic silver continuously. In the apparatus described, agitation is provided by an external pump. With the solution nozzles located tangential to a cylindrical cathode, high surface velocity is attained and mass flow held to reasonable values. Thus, the problem of excessive mechanical energy input is avoided, while the scrubbing velocity provided permits current densities as high as 10 amp/sq ft.

ELECTROLYTIC silver-recovery systems may be separated generally into two classes; those which operate at low current density with no solution agitation, and those which operate at high-current densities with vigorous solution agitation.

Low current density systems operate at 50 ma to 400 ma/sq ft of cathode,[1] but the higher currents are generally avoided. Since the permissible plating rate is affected by a variety of conditions, such as bath composition, silver concentration and gelatin concentration among others, and since these factors may vary considerably, nonagitated systems are usually operated at current densities of 50 ma to 100 ma, a range which is satisfactory for nearly all conditions. The systems are operated without careful control or supervision, and are best suited for processing rates which yield 2 to 3 oz of silver per day.

If we take a typical system operating with a sodium acid hypo bath, current density would be approximately 0.1 amp/sq ft of cathode. Assuming a typical current efficiency of 90%, a cell would require 100 sq ft of cathode surface in order to accommodate a film-processing rate of 1000 ft of 35mm film per hour. This indicates that low current density systems could not be employed in most motion-picture laboratories on the basis of space requirements alone.

In order to obtain recovery rates which are of practical interest to motion-picture laboratories and other film laboratories where the film-processing rate yields 20 oz or more of silver per day (equivalent to 20,000 ft of 35mm film), it is necessary to turn to the other class of electrolytic systems, those which are vigorously agitated and operate at higher current densities.

The chemistry of hypo baths during electrolysis is very complex and has been thoroughly presented elsewhere.[1,2] For our purposes, it is sufficient to note that the typical sodium hypo or ammonium hypo bath found in continuous processing machines is subject to electrolysis at practical rates by merely providing the proper physical conditions of vigorous agitation and continuous filtration.[2] A typical sodium acid hypo, which will tolerate 200 ma/sq ft without sulfiding under static conditions, will tolerate on the order of 10 times this current when agitated to provide a velocity of 1 ft/sec relative to the cathode.

Presented on May 1, 1957, at the Society's Convention at Washington, D.C., by Nicholas J. Cedrone, Hi-Speed Equipment, Inc., 73 Pond St., Waltham 54, Mass.
(This paper was received on August 5, 1957.)

Because of the high current densities which agitated systems will tolerate, it is possible to use them effectively in hypo systems containing several hundred gallons and which fix as much as a million or more feet of film per day. These recovery systems are more efficient in terms of weight of silver recovered as a percentage of total silver available and in terms of reduction of hypo costs.

Recovery Systems

Recovery systems operating at the higher current densities will tolerate current according to the silver concentration of the solution and the rate of solution agitation. Figure 1 shows the relationship between current density and the silver content, with the solution velocity held constant at 1 ft/sec.[3] Figure 2 shows the relationship between current density and agitation, with silver content held constant at 2.2 g/l.[3] In order for recovery to proceed at current densities in excess of 1 amp/sq ft, continuous filtration is also necessary to remove traces of sulfide which form intermittently at the cathode surface and would ultimately accumulate to an extent which would reduce the effective plating area or would eventually "poison" the entire plate.

The various arrangements for providing agitation have been listed by Hickman[2] as follows:

(1) air or gas bubbled between the electrodes;

(2A) rotating cathode, stationary anode; or

(2B) rotating anode, stationary cathode;

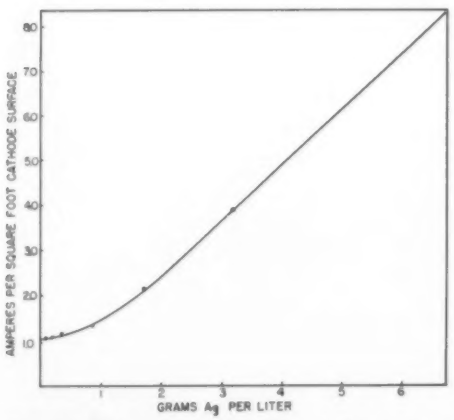

Fig. 1. Relationship between permissible current density and silver concentration.

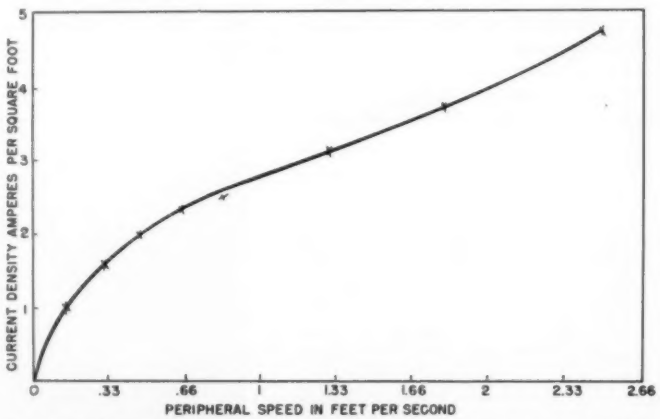

Fig. 2. Relationship between permissible current density and surface velocity at the cathode.

(3) paddles moving between anode and cathode;

(4) external pump stirring; and

(5) external paddle stirring.

At least one design based on each of the foregoing methods has been constructed and used. A recovery cell employing air turbulation was the first successful cell used in a motion-picture laboratory and was designed by Garbutt & Associates.[4] This design comprises a rectangular tank with alternate carbon and monel plates reaching across the narrow dimension and hanging down in the fluid. Air tubes are positioned between the plates at the lower extremities and release air blasts to provide the required agitation. Hickman points out three shortcomings of the air-agitated system.[2] The cathode is depolarized; the bubbles occupy space, reducing the effective plate area; and the foam produced tends to wet the electrode hangers.

An example of the rotating cathode design is set forth in a patent by Leverenz.[5] Essentially, this comprises a tub which may be the cathode, or a tub containing one or more concentric cylinders which form the cathode. A beam lies across the top of the tub and mounts a motor driving carbon anodes which are suspended in proximity to the cathode cylinders by a spider structure. Agitation at the surface of the cathode (both inside and outside each cathode cylinder) is provided by the action of the carbon anode sweeping past.

An example of the rotating anode method is shown by a device described by Duisenberg.[6] This consists essentially of a series of stainless-steel disks threaded onto a shaft with spacers to keep the disks separated by approximately $\frac{1}{2}$-in. Two slabs of carbon with the long dimension parallel to the shaft complete the array and the entire assembly is suspended in a hypo tank. In the design described, rotation of the shaft at a speed of 179 rpm provides the required agitation for an average maximum current density of 2.5 amp/sq ft. Systems of this type generally provide excellent plating but require disassembling in order to remove the silver.

The design which uses paddles moving between anode and cathode is probably the most familiar of all. Systems of this design are widely used by the larger motion-picture laboratories and were supplied by Eastman Kodak Co. as Model 1 and Model 2. The Model 1B (known as Hickman Cell) consists of a rectangular tank approximately 24 by 50 by 28 in. fitted with alternate carbon and stainless-steel plates, spaced about 2 in. apart, which reach across the narrow dimension of the tank and are suspended into the solution. The plates are slotted to permit straddling a shaft which carries sets of paddles arranged to occupy the space between the alternate plates. In the particular system described by Hickman,[2] the shaft carrying the paddles is rotated at about 80 rpm which permits a total current of about 200 amp on a total surface of 90 sq ft for an average current density of approximately 2.2 amp/sq ft.

By reducing the size of the cathode and making the cathode from a series of rods rather than a flat sheet, higher currents can be tolerated because of the more turbulent agitation resulting from the discontinuous surfaces. In one design, alternate rows of carbon-rod anodes and stainless-steel cathodes are used and agitation is provided by a standard or conventional propeller mixer mounted over the side at one end of the tank and positioned so as to direct flow in a path around the inside of the tank.[2]

External Pump Agitation

The principle of increased turbulence resulting from discontinuous cathodes was used in a design by Doran to obtain effective agitation by an external pump.[7] In this design, a rectangular tank is fitted with alternate rows of anode rods and cathode rods which are suspended from beams reaching across the top. The solution is withdrawn from one end of the tank and pumped back in at the other end. Since the tank cross section is so large compared to pipe-line area, average solution velocity through the tank is low but the discontinuities provided by rods create sufficient turbulence to allow plating at rates suitable for motion-picture laboratories.

Another application of external pump agitation is one discussed by Hickman[2] in which solution is recirculated by a centrifugal pump and discharged through nozzles placed between the plates. This arrangement was not considered successful because of high pump-power requirements and inferior plating relative to other systems.

A more recent example of external pump agitation is seen in the Model S-5 Silver Tower manufactured by Hi-Speed Equipment, Inc. The Tower comprises a cylindrical cathode and anode mounted concentrically on an insulated base plate (Fig. 3).* The Tower assembly is approximately 43 in. high and is mounted across the top of a sump tank which is approximately a 27-in. cube.

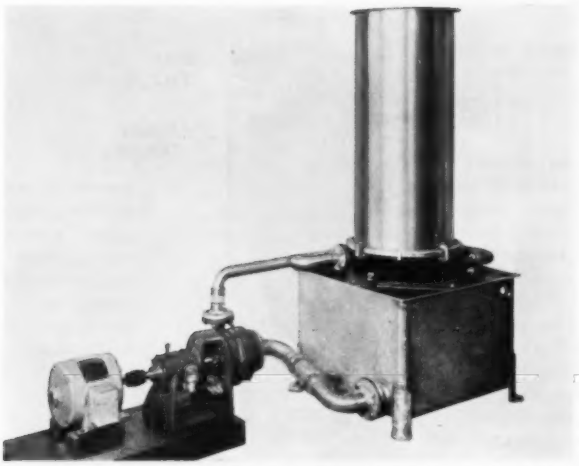

Fig. 3. "Silver Tower" assembly complete with recirculation pump and sump tank.

Hypo from the sump tank is pumped to the Tower through two nozzles which are tangentially located at the Tower base. These nozzles discharge into the annular space between the anode and the cathode and the solution is directed into a circular flow by the cathode. Because of the high kinetic energy of the fluid stream as it leaves the nozzles, the fluid continues to swirl and climbs in an ascending helix. This motion is represented by the arrows in the diagram (Fig. 4). Vanes located at the top of the anode deflect the fluid at four points and cause it to cascade toward the center of the Tower where it falls into a filter sock suspended concentrically within the anode. The fluid runs downward into the sump and is again recirculated by the centrifugal pump.

Velocity at the nozzle is calculated as 39.7 ft/sec. At the point just above the lower end of the cathode, the velocity in a horizontal plane is 9.8 ft/sec. At a point just below the top surface of the fluid, the velocity in a horizontal plane is 3.5 ft/sec. These velocities are obtained with a mass flow of 82 gal/min.

The combination of horizontal inlets and cylindrical cathode provides high surface velocity with relatively low mass flow.

By way of contrast, if the anode and the cathode were both unwrapped and made into flat sheets while maintaining the same area, the same height, and the same space between the two, we would find that a mass flow of 1000 gal/min would be necessary to provide an average velocity of 3.5 ft/sec over the cathode sur-

* Patent pending.

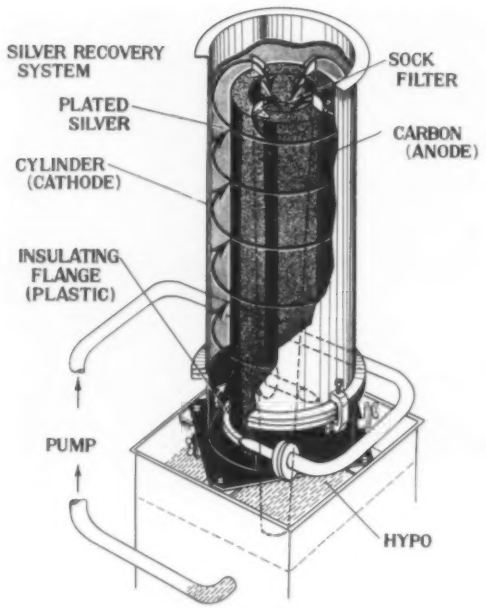

Fig. 4. Cutaway view of the Hi-Speed "Silver Tower."

face. The technique of circular flow is, then, clearly an effective means of reducing the pump horsepower without narrowing the anode-to-cathode space to the point of inviting treeing and short circuiting.

In operation, silver is plated continuously on the inside of the cathode and the solution is filtered continuously as it cascades through the center of the anode back to the sump tank.

Because the surface velocity in the Tower is considerably higher than in most "high-turbulation" systems, the normal current densities are also correspondingly higher. After an initial cover of bright plate is formed on the wetted surface of the cathode, the current is gradually increased as allowed by the silver concentration in the hypo. Current densities of 10 amp/sq ft have been maintained with acid hypo containing slightly more than 2 g of silver per liter. Ordinarily, the current is held to approximately 70 amp for a current density of 5.8 amp. This is in keeping with the widespread practice of providing an extra margin of safety in the operation of silver recovery systems so as not to endanger the hypo. At 70 amp and 75% current efficiency, approximately 6.8 troy oz of high-purity silver would plate on the cathode each hour.

The lowest velocity in the Tower occurs near the top of the cathode in the region above the anode. This area is, therefore, most susceptible to sulfiding and offers a convenient point for checking plate color and texture. Plating in the less visible region lower in the annular space will generally be as good or better than at the top, since surface velocity is higher towards the bottom.

When operating close to maximum recovery rates, the Hi-Speed Tower produces silver with a surface texture approximately that of fine sandpaper and with a tan color. The color was at first assumed to indicate imminent sulfiding. However, the color was not locked in with the plate but rather was in the form of a surface haze which required only gentle scraping to reveal bright silver directly underneath. This color was attributed to the oxidation products of carry-over developer as reported by Sharpe,[8] particularly since silver plate of this appearance was analyzed as over 99% pure silver.

After the silver plate has accumulated to a thickness of $\frac{1}{8}$ in. or more, the cathode is lifted from the Tower and the silver is removed. The bond between silver and stainless steel is normally a poor one. However, in the present case we have a cylinder of silver encircled by a cylinder of stainless steel. The silver is locked in place by what is termed "arch action" with each bit of silver acting as the keystone for its neighbors. This effect is an advantage while the cell is in operation because it prevents chunks of silver from falling away and possibly shorting the cell. To remove the silver, it is only necessary to chip out a narrow strip with a mallet or spatula and thus effectively remove the "lock" holding the silver. Large sheets of silver can then be peeled inward without difficulty.

This equipment is the result of an attempt to design a silver-recovery system which would require a minimum maintenance, yet permit high recovery rates. The first models fell short of the goal and were susceptible to shorting. An improved design followed in which the anode-to-cathode space was increased to 2 in. and the method of insulating the base was changed from rubber to PVC (polyvinyl chloride). With the shorting difficulty eliminated, the pump appeared to be the only remaining source of possible difficulty and a sturdy, conservatively rated unit was selected.

Units of the current design have been in operation for over one year without any breakdown or maintenance problems reported.

Acknowledgment

The author wishes to thank H. E. White of Eastman Kodak Co. for information and comments pertinent to the design.

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Cold Mirrors for Projection Heat Control

From BALZERS LABORATORIES

Light sources used in motion-picture projection radiate heat in the form of infrared radiation as well as visible light. While the infrared radiation increases problems of overheating and film distortion it does not contribute to the screen image; therefore, maximum reduction of infrared radiation with minimum visible light loss is essential with the use of the high energy output of present-day projection light sources. A front-surface-coated projection lamp mirror is described which reflects to the film a high percentage of visible light, but which transmits through the mirror most of the infrared. Comparisons are made between front-surface-coated mirrors, rear-surface-coated mirrors and absorption-type heat filters.

THE LIGHT SOURCES used in motion-picture projection equipment are carbon arc and xenon lamps. Part of the energy radiated by these lamps is visible light. Another part lies within the range of invisible infrared radiation also referred to as heat radiation.

The visible radiation or visible light emitted by the lamp is directed to the film gate of the projector via optical units, such as mirrors or, in certain cases, lenses. There it impinges on the film and, depending on whether the picture is light or dark, is more or less absorbed by the photographic emulsion on the film and converted into heat. The portion which is not absorbed, i.e. the light which impinged on the light areas of the film, proceeds through the projector lenses to the screen. The conversion of the absorbed light into heat as just described causes the film to heat up.

The invisible infrared radiation follows the same path as the visible light to the film gate where it is also absorbed by the film to a greater or lesser degree. The infrared radiation is converted into tangible heat in the same way as the absorbed light and thus contributes to raising the temperature of the film. The non-absorbed infrared radiation then proceeds through the projector lenses, which are in turn heated by absorption, to the screen.

The absorption by the film of a percentage of the visible light is the determining factor for the production of the projected image. There is as yet no way of preventing the light energy absorbed in the film from being converted into heat.

The invisible infrared radiation, too, which is inevitably absorbed within the film, is also converted into tangible heat, thus contributing to the film heating up. Steps must therefore be taken to keep this invisible infrared radiation off the film altogether, since it is not needed for the production of the image. If the infrared radiation is prevented from reaching the film, the film will be cooler than before, the only heating still taking place being that caused by the necessary absorption of the visible light.

The possibility of reducing the extent to which the film is heated depends on the proportions of visible radiation and infrared radiation emitted by the lamp employed and on the extent to which the visible light can be separated from the infrared radiation. In the absence of suitable means for filtering off the infrared radiation, systems of film cooling in cinemas were introduced as far back as 20 years ago. Although these were unable to stop the heat radiation, they enabled the heat generated in the film to be conducted away, thus keeping the temperature within certain limits.

Where this type of film cooling was insufficient by itself, heat filters were installed in the lamps. These were absorption filters, i.e. filters which absorb the infrared radiation and thus heat themselves up to a considerable degree. As a result of this measure less infrared radiation falls on the film, but the considerable heating of the filters led to their destruction. Their use was restricted in particular where a high light output was demanded, making good filtration more necessary than ever. Moreover, these filters had the great disadvantage that their use involved a loss of light of about 20–25%.

Only in recent years has an advance been made in the field of heat protection. Instead of absorption filters, which absorb the infrared radiation and, as a result, heat themselves up, reflection filters were developed which, operating on the interference principle, reflect part of the heat back into the lamp housing, allowing the visible light to pass through. With these filters the loss of light is only 10%. If the use of such heat filters was not a complete solution, this was due to the fact that the infrared radiation was only partially restricted and there are still losses of light.

In spite of heat filters and in spite of effective film-cooling systems, large-screen projection and, in particular, drive-ins, still involve temperatures dangerously close to the permissible limits. It is known that even in cinemas of moderate size the undesirable effect of a high proportion of heat radiation in the projector beam manifests itself in considerable film buckle. This is a phenomenon which gives rise to considerable blurring especially in wide-film projection where short-focus lens systems are used, and which shows that the film cannot maintain its proper flatness once it has been exposed to excessive heat.

The principle of the cold mirror has been known for a long time. A cold mirror reflects the visible light in the manner of an ordinary mirror or even better, while the infrared radiation passes straight through. The function of such mirrors is based on the interference principle. A number of coatings having a thickness of about one quarter of the wavelength of the light are applied to a glass element (Fig. 1).

The coatings consist of alternate layers of materials of high and low refractive index. Actually such mirrors have been manufactured for many years, but there were difficulties in that, on the one hand, the necessity of maintaining the accuracy of the layer dimensions (about 0.1 μ in thickness) presented manufacturing problems and that, on the other hand, the coating materials used were relatively soft and chemically not very stable so that their employment in practical cinema operation involved great difficulties. Attempts have also been made with these substances to apply reflecting layers on the back of the mirror blanks — as is customary with normal silver coat-

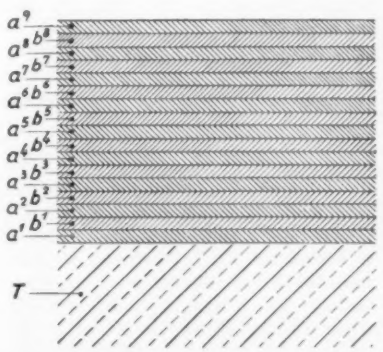

Fig. 1. Arrangement of multilayer interference coatings.

A contribution submitted September 27, 1957, by the Thin Films Laboratory of Geraetebau-Anstalt Balzers, Principality of Liechtenstein (Swiss Customs Area).

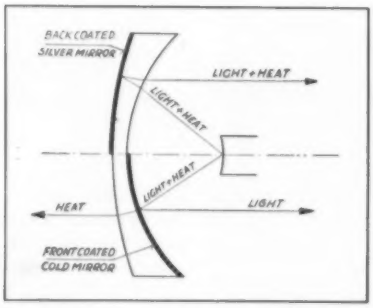

Fig. 2. Path of rays on conventional silver back-coated mirror and on front-surface cold mirror.

ings — subsequently protecting these sensitive layers with films of varnish. But this solution, too, involves difficulties of manufacture and stability.

Several years ago particularly efficient processes were successfully developed by means of which hard and chemically stable layers could be produced by thermal evaporation of suitable materials under vacuum. This enables front-surface cold mirrors to be manufactured which will stand up to the demands of practical operation.

Figure 2 shows diagrammatically the path of rays in a cinema projector using the conventional silver-backed mirrors and front-surface cold mirrors.

With the silver mirror coated on the back, the visible light coming from the arc lamp passes through the mirror glass, is reflected at its back with an absorption loss of a few per cent, passes through the glass a second time and then proceeds to the film gate. About 85% of the visible light impinging on the mirrors gets into the plane of the film gate. The infrared radiation also passes through the mirror glass but is partly absorbed and subsequently reflected by the silver to the extent of 90%, passes through the glass again with renewed absorption and then reaches the plane of the film gate. The absorption losses during the two passages of the infrared radiation through the glass, and the reflection losses of the visible and the infrared light at the silver cause the mirror to warm up.

With the front-surface cold mirror the visible light coming from the arc lamp first impinges on the cold mirror coating, being reflected by the latter with a loss of only 5%, and therefore reaches the plane of the film gate to an extent of 95%. The 5% loss is caused by the fact that the cold mirror coating as now in use allows about 5% of the light to pass through. A reduction of this loss presents no technical problem but is largely a question of cost. The lost light passes into the space behind the mirror, i.e. it is not absorbed by the mirror and therefore does not heat it up. Of the infrared radiation, only a small part (about 10%) is

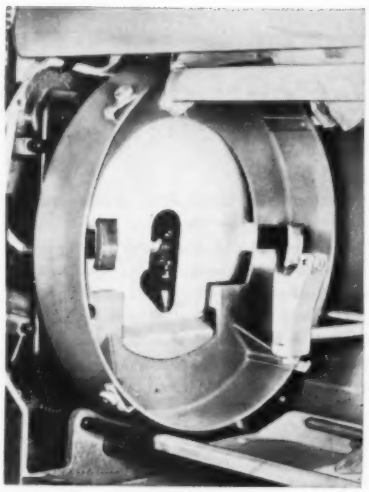

Fig. 3. Diffusion disk.

reflected by the cold mirror coating, the remaining radiation passing through the mirror glass once, only a small amount being absorbed without heating up the glass to any appre- ble extent, after which it passes into a space behind the mirror. Figure 3 shows a diffusion disk in the mirror frame of a Bauer reflector lamp. The energy passing through the front-surface cold mirror is converted into heat at this disk and subsequently completely eliminated by the outlet of the lamp housing.

It can be seen that with the front-surface cold mirror the infrared radiation is separated out of the beam of visible light and is thus no longer able to heat the film. In addition, more visible light reaches the film gate than with a silver mirror, and there are also a number of other advantages.

The visible light does not pass through the mirror glass, being reflected on the surface. Therefore only one side, i.e. the front, of the mirror glass requires optical treatment. The mirror glass itself may have striae and other faults and may also be colored. This freedom in the selection of glass facilitates the use of heat-resistant glass. Because of the high melting points of the coatings used, splashes from the carbon arc cause less damage to the cold mirror coating than to the glass surfaces of silver-backed mirrors. Figure 4 shows a front-surface cold mirror and a conventional mirror after about 12 months' operation. While the front-surface cold mirror shows practically no surface injuries, the ordinary cinema reflector has suffered considerable damage through a great number of burnt-in splashes. For this illustration the current load was 65 amp. There are, however, cold mirrors in use with arcs on loads of 145 amp.

In addition, the effect of injuries caused by splashes is doubled in the case of

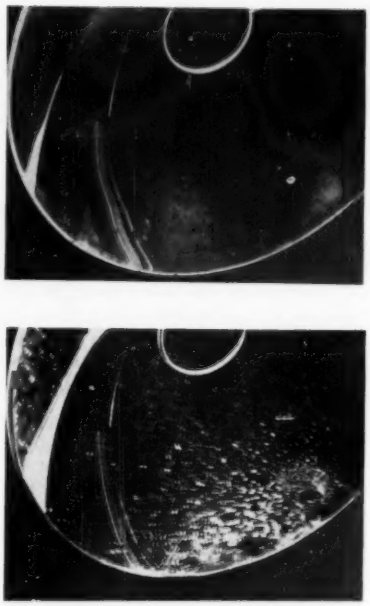

Fig. 4. Front-surface cold mirror and conventional mirror after 12 months' operation.

silver-backed mirrors. Both on entry and exit light is dispersed and thus lost. The top half of Fig. 5 shows how a double loss of light results from a flaw in the glass surface of a silver-backed mirror. Both the beam impinging directly (continuous line) on the glass and the beam (dotted line) reflected from the back is shaded by the burnt-in splash A. In the case of the front-surface mirror, however, damage to the coating involves only a single loss of light (see bottom half of illustration).

Visible light is not absorbed at all by the front-surface cold mirror and infrared radiation only to a very slight extent as it passes through the mirror glass in one direction. In the case of the silver-backed mirror the entire loss of visible light by absorption is converted into heat in the silver layer in addition to the infrared radiation which passes through the glass twice and is partly

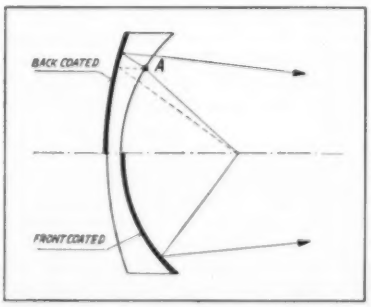

Fig. 5. Above — light loss with conventional mirror; below — light loss with front-surface cold mirror.

absorbed by the silver. The amount of energy absorbed in the mirror is therefore much smaller in the front-surface cold mirror than with the silver-backed mirror. For this reason the latter is subjected to much more intensive heating. The possibility of using heat-resistant glass on the one hand, and the slight heating of the mirror by absorption on the other, almost completely eliminates the danger of the mirror glass cracking.

To summarize, the front-surface cold mirror, as compared with the conventional silver-backed cinema reflector, is characterized by reduced film heating in spite of greater light intensity; more light at identical power; maximum utilization of the new and more powerful lighting systems; longer service life of the mirror due to smaller reduction of the reflecting power as a result of damage by splashes; diminished danger of cracking because of the reduced heat and the possibility of using heat-resistant glasses.

The front-surface cold mirror thus increases the performance of the projectors and makes them more economical in use, it offers greatly increased protection to the film and opens up new possibilities for 35mm film. These considerable advantages have caused projector manufacturers to change over to front-surface cold mirrors to an ever increasing extent.

83d Convention Los Angeles April 21-25

ACTIVE preparations for an outstanding convention have been gathering momentum and each successive mail brings word of more important program material and additional arrangements for the convenience and diversion of convention visitors.

As far as entertainments are concerned, one feature which has always been much enjoyed at former Los Angeles conventions will be repeated—the Aquacade show in the beautiful Ambassador pool during the cocktail party held in the open air on the terraces around the pool. The open-house Coffee Shop, which has come to be a friendly feature of recent conventions, will be sponsored this time by the Hollywood Film Co.

The ladies attending the convention will find much to do in and around Los Angeles and Hollywood. One tour will take them to Disneyland, another to the fascinating Marineland of the Pacific at Palos Verdes; there will be a luncheon at one of the famous Hollywood restaurants, a tour of the Max Factor plant, a luncheon and fashion show at the smart new Beverly Hilton, and other features, if time permits.

If hotel reservations have not yet been made, this should be attended to without delay. Rates were published in the February *Journal*, p. 106, and a return postal card for sending direct to the hotel was attached to the postal announcement mailed to members about two weeks ago. Reservations should be sent to: Reservation Department, Ambassador Hotel, 3400 Wilshire Blvd., Los Angeles 5.

Equipment Exhibit

Reservations that have been made to date give promise of a display of equipment that will be remarkable, even by previous Los Angeles convention standards. Visitors can expect to see many new and important items among the exhibits staged by the following companies:

Animation Equipment Corp., Booth 203
Bell & Howell Co., Booths 216, 218
Birns & Sawyer, Booth 201
Camera Equipment Co., Booth 204
Andre Debrie Mfg. Corp., Booth 101
Electronic Systems, Inc., Booth 110
Encyclopaedia Britannica, Booth 209
Great Books of the Western World, Booth 109
Karl Heitz, Inc., Booth 117
Frank Herrnfeld Engineering Co., Booth 118
Hollywood Film Co., Booth 121
Houston Fearless Div., Booths 106, 108
Kinevox-Hallen Div., Booth 210
Kling Photo Corp., Booths 206, 208
Lipsner-Smith Corp., Booth 219
Magnasync Mfg. Co., Booth 202
Mole-Richardson Co., Booth 217
Motion Picture Printing Equipment Co., Booth 212
Moviola Mfg. Co., Booth 120
Photo-Sonics, Inc., Booth 104
Precision Laboratories, Booth 111
Prestoseal Mfg. Corp., Booth 113
RCA Film Recording, Booth 115
Reevesound Co., Booth 205
S.O.S. Cinema Supply Corp., Booth 102
Traid Corp., Booth 220
Unicorn Engineering Corp., Booth 119
W. M. Welch Mfg. Co., Booth 214
Westrex Corp., Booths 103, 105

Members will shortly receive a booklet guide to the Exhibit, describing what each of the above companies plans to show. Meanwhile, last-minute orders for exhibit space should be rushed to the Exhibit Chairman, John B. Olsson, Houston Fearless Div., 11801 W. Olympic Blvd., Los Angeles 64.

Tentative Schedule of Committee Meetings

Monday, April 21
9:30 A.M. Screen Brightness
10:00 A.M. Education
2:00 P.M. Film Projection Practice

Tuesday, April 22
10:00 A.M. Television
10:00 A.M. Papers
11:15 A.M. Board of Editors
1:30 P.M. Standards
2:00 P.M. Publications Advisory
2:30 P.M. ASA Sectional Committee PH22

Wednesday, April 23
10:00 A.M. Film Dimensions
2:00 P.M. High-Speed Photography
2:30 P.M. Section and Student Chapter Officers

Thursday, April 24
10:00 A.M. Laboratory Practice
2:00 P.M. Color
2:30 P.M. Public Relations Advisory

Friday, April 25
10:00 A.M. Motion-Picture Studio Lighting
2:00 P.M. Sound

Final schedule will be listed in the Convention Program and meeting notices will be mailed to Committee members.

The Association of Cinema Laboratories plans to have a breakfast meeting on Monday, April 21.

SMPTE Color TV Test Slides

The Society's TV Committee has released a new set of 2 by 2-in. slides for checking the performance of the color TV film reproducing system. This set of six slides replaces the Society's previous set of 11 slides.

There are now two color slides exemplifying extreme variation in picture quality like that often supplied for reproduction: one slide has extremely high dye density such as is often found in color prints; the other slide is of high-contrast ratio typical of extreme variations which systems have to accommodate. Three slides are representative of good color picture quality for which lighting of 2-to-1 ratio between key and fill lighting has been chosen as most desirable for color television.

The sixth slide, in black-and-white, is an alignment and resolution target which shows the portion of the projected film frame to be reproduced. It has eight arrow points at the edges of the area to be scanned to show when the projector and camera are properly aligned. Resolution is checked by a calibrated wedge design ranging from 250 to 500 lines. Small corner circles permit checking both optical and electrical focus.

The price of the set of six is $12.50; the black-and-white slide may be purchased separately at $2.50.

Advance Program

Unavoidable shifts in schedule and changes or additions to the papers listed sometimes occur after publication of the Advance Program. Barring these minor variations which may become necessary before or even during the Convention, the events on this program will take place in the order given here.

Detailed information is available from SMPTE headquarters in New York (LOngacre 5-0172). It is suggested that inquiries relating to scheduling of individual papers, committee meetings or other information that does not appear in the Journal should be made by telephone during the week preceding the Convention. Dates and schedules can also be confirmed directly with the Program Chairman, Herbert Farmer, whose number in Los Angeles is RIchmond 8-2311, Exts. 328, 269, 200.

SUNDAY—APRIL 20

2:00 Registration opens in the Main Lobby, Ambassador Hotel

MONDAY—APRIL 21

9:00 Registration

10:00 GENERAL SESSION

A Direct-Drive Automatic Iris Control
MERVIN W. LARUE, JR., *Bell & Howell Co., Chicago*
A new type of automatic iris control is incorporated in the Bell & Howell Design 290 8mm camera. The iris control is operated solely by power from a photovoltaic cell, made feasible by the exceptionally low power requirements of a unique rotary "barn-door" iris. The method of construction results in a highly shock-resistant mechanism with almost unlimited service life. The automatic control is described and some of the design considerations discussed.

Automatic Film Cleaning Machine With High-Speed Process Cycle
ROBERT GRUNWALD and HOWARD BOWEN, *The Harwald Company, Inc., Evanston, Ill.*
A high-speed film cleaning and conditioning process involving the use of solid additives in the cleaning solvent has recently been developed. The solid additives, intended to lubricate the film and prevent scratches, must be applied in controlled quantities. This is accomplished through use of closely controlled concentration of solids in the solvent and by electronically controlled fluid feed which allows accurate adjustment of film "wetness."

Lenses for 35 mm Film Cameras
GORDON HENRY COOK, *Taylor, Taylor & Hobson, Ltd., Leicester, England*
An earlier paper by the author (in the March 1956 Journal) discusses the optical problems to be overcome in providing a standard of performance which is adequate for subsequent enlargement at a considerable scale on large viewing screens in the theater. The present paper describes the characteristics which hitherto have limited the performance of conventional lenses and shows how the application of new design techniques together with the use of new optical materials has led to the development of a new and complete range of camera lenses to suit modern requirements.

12:00 Get-Together Luncheon

MONDAY AFTERNOON

2:30 CLOSED-CIRCUIT TELEVISION

Industry Standardization Effort in the Closed-Circuit Television Field
ROBERT G. DAY, *General Electric Co., Syracuse, N.Y.*
Recent SMPTE action indicates an interest in technical standards for closed-circuit television. The areas in which SMPTE can best contribute without duplication of effort are discussed, in addition to the background, organization, status, plans and problems of EIA activity in the field.

Aspect Ratio Treatment at Bartlesville
F. N. GILLETTE, *General Precision Laboratory Inc., Pleasantville, N.Y.*
A new electronic method of compressing CinemaScope and VistaVision films makes it possible for them to be shown on standard-size home TV screens, without noticeable cropping or distortion. The control console and installation features of interest are described.

Zoom Lenses for Closed-Circuit Television
FRANK G. BACK, *Zoomar, Inc., New York*
In the rapidly growing field of closed-circuit TV, zoom lenses have become of ever-growing importance. Several zoom lenses are already on the market. The different characteristics of these lenses and their advantages and disadvantages are discussed and their function demonstrated by pictures and diagrams on a television chain.

Generating and Processing Television Signals for Narrowband Transmission
DONALD M. KRAUSS, *General Electric Co., Syracuse, N.Y.*
The cost of wideband transmission over long distances has been a serious obstacle to the application of closed-circuit TV in many problem areas. Where the customer will tolerate reduced resolution and loss of continuous motion, some promising approaches to the problem are available. A survey is made of several methods of generating, transmitting and processing narrowband TV signals, with particular emphasis on a system utilizing conventional pickup and display equipment operating at standard scanning rates.

Sensitivity and Speed of Television Camera Tubes
R. G. NEUHAUSER, *Radio Corp. of America, Lancaster, Pa.*
The sensitivities of various camera tubes are determined in terms of the illumination levels required for both standard and nonstandard TV scanning rates. For convenience, these values are given in terms of equivalent ASA film exposure index values to facilitate the use of a common exposure meter to determine scene light or iris settings. The effective speeds of various camera tubes are also evaluated in terms of the ability to stop motion. This factor is evaluated both from the standpoint of deriving intelligence from the signal and from the standpoint of the aesthetics of the picture, i.e., absence of negative image or "long tail" carry-over of signal. The effects of over-exposure or of under-exposure on the speed of different camera tubes are also illustrated.

MONDAY EVENING

8:00 THE PAST AND THE FUTURE

The George Eastman House Film Collection
JAMES CARD, *George Eastman House, Rochester, N.Y.*
The George Eastman House opened in 1949 as a nonprofit museum of photography and cinematography. It contains a collection of motion-picture apparatus and a film library of some seven million feet, stored in specially constructed vaults. A program of copying nitrate film on acetate stock is in progress. Films are shown in the Dryden Theatre to visitors, to the 3000 members of the Dryden Theatre Film Society, and to special groups.

Language Translation by Machine
MAX G. KOSARIN, *U.S. Army Pictorial Center, Long Island City, N.Y.*
Projects are in progress throughout the United States and overseas, involving mechanical translation of foreign languages, utilizing the electronic computer. The mechanical translation process consists of four general steps: coding the source language for input data; producing word-for-word translation; translation of sentences and phrases; output of complete translation in target language. Machine translation is possible for foreign versions of motion pictures. The problem of obtaining an automatic print reader offers a challenge to the engineer engaged in the motion-picture and television industry.

Pay TV—Why the Controversy?
LLOYD HALLAMORE, *Hallamore Electronics, Inc., Anaheim, Calif.*
Pay TV will, it is believed, have to be a wire system and a telephone utility the organization to install and maintain the system. A new approach to Pay TV by completely wired communities is the use of the system for local free TV during the daytime hours with movies shown for a fee in the evening. When complete communities are wired for TV, the cables can be used for other industrial and community service closed-circuit TV programs, such as police, educational and medical training. It is believed that the entire movie industry from producers through exhibitors should be supporting the Pay TV plan, not fighting it, because it will greatly expand the field for motion pictures, and so the exhibitors are the logical operators of the Pay TV system.

TUESDAY—APRIL 22

9:00 SOUND RECORDING

Electrostatic Uniangular Microphone
HARRY F. OLSON and JOHN PRESTON, *RCA Laboratories, Princeton, N.J.*
The electrostatic uniangular microphone consists of an electrostatic transducer combined with an acoustical network to provide a uniform response with respect to frequency and a uniangular directivity pattern. The microphone exhibits a high order of directivity. The polar directional pattern is independent of the frequency.

Variable-Area Process Control Using Distortion Balance
RALPH R. WELLS, *Columbia Pictures Corp., Hollywood*
Processing of variable-area sound for television presents problems of time, quality and adaptability. Methods for using a new pulsed-signal generator provide a practical approach to the problems. Tests may be evaluated with a meter, oscilloscope, densitometer, or even a common loudspeaker. A new graphic technique provides process data not heretofore available.

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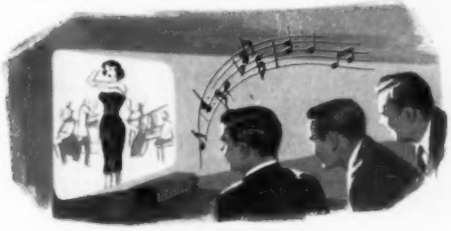

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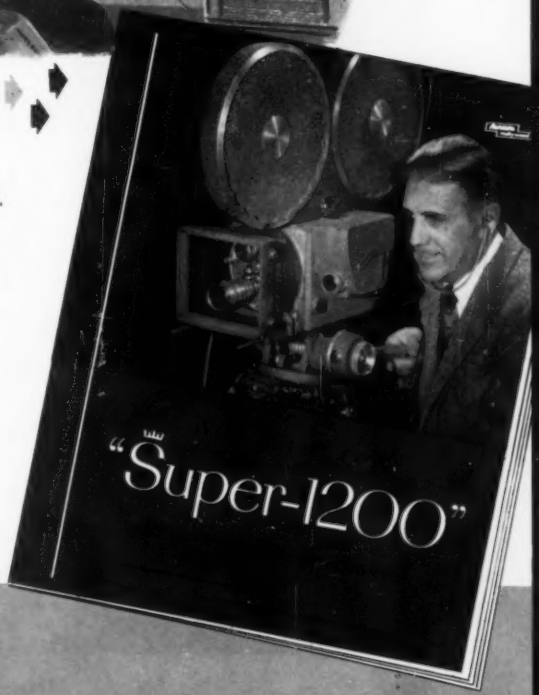

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An Investigation of Splicing "Pops" in Magnetic Tape
PHIL SWEENY and RALPH R. WELLS, *Columbia Pictures Corp., Hollywood*
The causes and remedies of "pops" due to splices have been investigated. The sources of several common causes have been traced. Several nonmagnetic materials were investigated as were splicing techniques. Splicer modifications, blooping and preventive maintenance have been used to overcome the effects.

A Portable Sprocket-Type Magnetic-Tape or Film Recording System
G. R. CRANE and E. W. TEMPLIN, *Westrex Corp., Hollywood*
Three professional magnetic recording systems have been designed, employing sprocket-hole ¼-in. tape or 16mm or 17½mm films, which meet the operating and quality requirements of the motion-picture industry. One of two small carrying cases contains a two-position mixer, including preamplifiers, recording amplifier and the 115-v a-c system power supply. The recorder includes a bias oscillator and monitor amplifier, both transistorized. The recorder operates synchronously from an a-c line or from power derived from the camera motor.

A Versatile Studio Photographic Recording System
G. A. BROOKES and H. A. MANLEY, *Westrex Corp., New York*
A variable-area or density photographic recording system has been designed with optional magnetic recording facilities. A short cabinet, containing transmission equipment of new design, and an associated table and recorder form a compact operating unit. The recorder provides a simplified film path for photographic and magnetic recording, improved optics and a novel visual monitor. Of particular interest are transistorized monitor amplifiers, simplified exposure meter and an improved compressor-amplifier which should find wide application.

An Integrated Sound-Service Studio for 16mm Production
ROBERT W. EBERENZ, *Byron Inc., Washington, D.C.*
After discussion of the physical construction of the new studios, the acoustical treatment and placement of equipment for ease of operation are illustrated with drawings and color slides. Special attention is given to the equipment selected for the studio: the unique new Westrex RA-1581 optical and magnetic recorder and its associated transmission system, including double-speed optical transfer operation and other associated equipment; the new eight-position recording console; looping facilities; and the motor reversing and control system.

TUESDAY AFTERNOON

1:30 INDUSTRIAL AND INSTRUMENTATION PHOTOGRAPHY

Design for Destruction
GLENN E. MILLER, *Lockheed Missile System Div., Van Nuys, Calif.*
Design for Destruction is a comprehensive film depicting the uses of Instrumentation Motion Pictures. Beginning with a short history of instrumentation cinematography, it describes specialized equipment and rigorous camera testing as well as present-day uses of films such as high-speed, on-board, schlieren, tracking and documentary. Photographed in 35mm Eastman Color negative, the film uses many actual scenes taken from recovered instrumentation cameras to provide a spectacular as well as informative film on modern uses of cinematography.

Ballistic Cameras
WILLIAM PABST, *White Sands Proving Ground, N. M.*
The requirements of cameras for ballistic studies are outlined, with related design characteristics.

A New Framing Camera
MILTON C. KURTZ, *Beckman & Whitley, Inc., San Carlos, Calif.*
The Beckman & Whitley Model 192 Framing Camera has been designed by retaining all the advantages of the existing framing cameras, but with additional capabilities of not requiring synchronization with the event under study, longer writing time, and greater number of frames. Reasons for construction, the design parameters, and performance specifications are presented. Slides will show the fabrication of the first unit.

Electrical and Optical Characteristics of an Ultra-High-Speed Electronic Camera
R. CARROLL MANINGER, *Precision Technology, Inc., Livermore, Calif.*
An electronic camera has been designed with an image-converter tube which contains a grid to serve as a shutter, and a set of plates which permit deflection of images on the phosphor anode for multiple-frame and streak photography. The discussion is concerned primarily with characteristics such as spatial and time resolution, spectral response, light amplification, accuracy of synchronization with events, and image distortion. Particular attention is given to the characteristics most important in the photography of events that occur within 0.01 to 100 microseconds.

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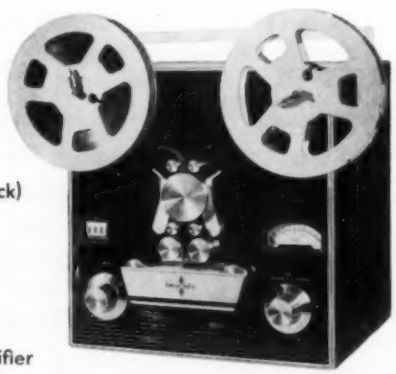

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Image Illuminance and Irradiance With Carbon-Arc Image Furnaces

M. R. NULL and W. W. LOZIER, *National Carbon Company Research Laboratories, Division of Union Carbide Corp., Cleveland*

Carbon-arc motion-picture projection lamps are useful in the production of extremely high flux densities of radiant energy. The application of these to carbon-arc image furnaces has already been described. They are likewise valuable in many studies requiring high concentrations of radiant energy in any portion of the spectrum from the arc. Comparisons are made of the distribution of irradiance and illuminance across the image with three different types of optical systems. The spectral distribution of irradiance at the center of the image is also given.

Fast Photography in High-Temperature Physics

J. GAUGER, W. STARR and V. VALI, *Lockheed Aircraft Corp., Missile Systems Div., Palo Alto, Calif.*

Image-converter techniques have been applied to studies of shock-wave phenomena, electrical-discharge studies and spectroscopic measurements. Methods of obtaining pertinent data in each case are compared and experiments performed and proposed are discussed.

Photographic Techniques Applied to Recording Supersonic Track-Sled Shockwave Formations

NEIL KRENZEL, *U. S. Naval Ordnance Test Station, China Lake, Calif.*

A brief description is given of the various means available (schlieren, shadowgraph, and synchronized streak) to record shock waves produced by supersonic track sleds. Examples of the results obtained from the application of some of these techniques are included.

Color Exposure for High-Speed Photography of Some Self-Luminous Events

K. H. LOHSE, *Edgar C. Bain Laboratory for Fundamental Research, U. S. Steel Corp. Research Center, Monroeville, Pa.*

Many problems encountered in high-speed photography of variable self-luminous events such as fires, flames, liquid metals and furnace interiors can be overcome with lens attachments. A new approach to exposure calculation, using computed speed-characteristic curves of cameras, is explained and examples given. Slides and 16mm high-speed motion pictures illustrate the article.

X Minus Eighty Days

A color motion picture and discussion of the role played by the California Institute of Technology, Jet Propulsion Laboratory, in the building and launching of America's first earth satellite.

TUESDAY EVENING

8:00 CINEMATOGRAPHY (at M-G-M Studios)

Increased Depth of Field for Motion-Picture Photography

SIDNEY ZIPSER, *Technicolor Corp., Hollywood*

Greater depth of field has always been desired in motion-picture photography, particularly now with wider screens and larger camera apertures. A practical comparison is made of the lens focal lengths commonly used today, showing their depths of field in relation to focal distances and f-stops. A camera aperture pivoting on its vertical center and accurately calibrated is proposed as one means of achieving depth in a diagonal plane, permitting more dramatic staging.

Conformal Printing System for Todd-AO Projection

BRIAN O'BRIEN, *American Optical Co., Southbridge, Mass.*

The system described compensates in a single printing step for projection keystone, for horizon curvature due to curved screen, and for vertical line curvature due to barrel distortion introduced in very wide angle camera lenses. Resultant projected image appears substantially conformal. Since projection keystone and horizon curve are constant for all scenes, while barrel distortion changes with camera lens, correction for the latter is programmed automatically from scene to scene together with color and exposure corrections in printer.

Large Area Negative Printing at Technicolor

W. E. POHL, *Technicolor Corp., Los Angeles*

The background of large area negative photography and processing for use at Technicolor is reviewed, together with techniques for producing anamorphosed and deanamorphosed type prints from such negatives.

Large-Area Negative Photography at M-G-M

DOUGLAS SHEARER, *Metro-Goldwyn-Mayer Studios, Hollywood*

After a discussion, large-area production photographic systems and techniques used at M-G-M Studios will be demonstrated.

In Re-recorders . . . *Westrex* presents a

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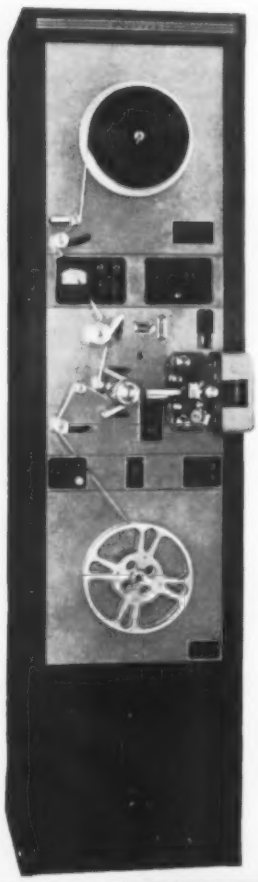

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The controls are arranged for quick accessibility and for simplicity of operation with fast run-down to the desired location for interlock operation.

The new magnetic-optical pre-amplifier provides reproduction from either standard or double-width variable-area track or from magnetic track at the same nominal output level.

The plug-in amplifier provides a flat or pre-equalized low-end characteristic. Equalization is adjustable for optical scanning and transfer losses.

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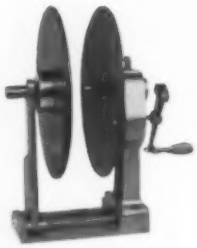
precision film editing equipment



NEGATIVE REWIND

The unit is designed as a fool proof method to tightly wind original material without the danger of tearing or scratching the film. The rolling action of the cover flange self-aligns the film constantly.

$125.00 EACH
NRU-1 (1000′ flanges)
NRU-1L (2000′ flanges)

EASY EDITOR

Reels driven by friction, this permits the operator to quickly remove reels and insert others.

Braking levers prevent film pileup.

Six 1000′ 35mm reels can be rewound at the same time.

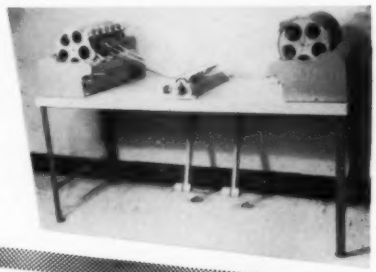
Motor rewinds wind film in either direction.

Micro switches cut off power after last reel has run out.

Available with foot controls.

PER SET.....$920.00

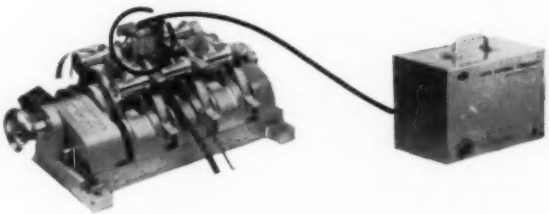
WITH FOOT CONTROLS $975.00



DIFFERENTIAL REWIND WITH GIMMICK

Four (4) uneven reels of film can be wound up evenly on a single shaft. 16 or 35mm film or a combination of both may be rewound. Each reel is handled individually on the four (4) reel shaft and even takeup of all reels is assured. Two (2) reels are driven by the differential action of the rewind and the others with the differential gimmick.

$135.00



POWER REWIND

Designed to wind 16 and 35mm film on reels up to and including 3000′ rolls.

A heavy duty 1/10 HP variable speed motor controlled by a carbon pyle foot rheostat, permits the operator to vary the speed during the winding operation. A side lever shifts the motor to either neutral or engaged position. Neutral position is used when the film is being wound back on the hand rewind. It permits the reel to free wheel without fighting the thrust of the motor. Film can be wound on cores with the aid of the HFC tightwind TWC-1 (16-35) combination.

$124.50

TIGHTWIND COMBINATION (16-35) $35.00

FILM SYNCHRONIZER

HFC film synchronizers enable the film editor to accurately match the picture and sound track.

All types of synchronizers of 16 or 35mm are available from stock, as well as 16 & 35mm combinations; and 35 - 32 and 35mm combinations. Units to handle 55mm, 65mm and 70mm are available on special order.

MAGNETIC TAPE SYNCHRONIZER ATTACHMENT

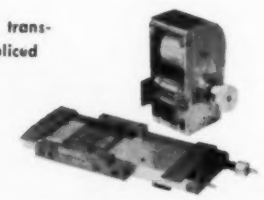
This attachment permits the user to sync dailies quickly without using the editing machine.

It can use the amplifier in the editing machine or sound reader, or the HFC tape reader amplifier especially made for this use.

AUTOMATIC FILM SPLICER

The HFC Automatic Film Splicer uses a special transparent tape, perforated to match the film to be spliced and coated on one side with pressure adhesive. The tape is rolled onto the film automatically from a precision sprocket. Registration pins assure perfect lineup of film. 16 and 35mm models are available.

$185.00 EACH



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WITH ADVANCED DESIGN . . .

KEEP UNICORN IN MIND

UNICORN ENGINEERING CORPORATION

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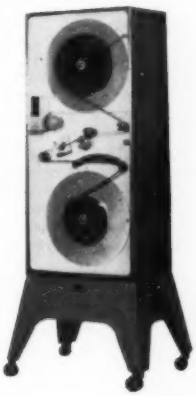
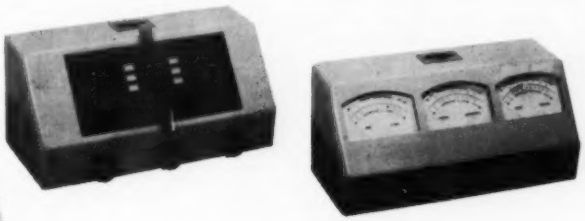
CLEANER REWIND



For use in printing room, film to be cleaned can be quickly removed from printer, set into cleaned rewind and printed without delay.
Fully automatic — will quickly clean, remove dust and rewind up to 3000' film rolls in one operation at 250' per minute.
New type air and vacuum squeegee unit*.
Maximum protection against scratching — only edges touch machine's surfaces.
A torque take up device maintains film tension.
Uniform regulated windup eliminates scratches.
Operates on film spools with either 115 V 60 cycle AC also 220 V 60 cycle AC & 3 phase.
Dry cleaner — no odor — no ventilation required.
Automatic cutoffs when door is opened or roll runs out.

MODEL D — 2032 - .35mm $4,200.00
MODEL D - 2034 - A $4,375.00

* Patent Pending



COLOR TIMER

A scientific instrument specifically designed to enhance the timer's skill and judgement and record, simply and quickly, those corrections he deems necessary to produce the desired results.

Simple to use.

Saves time in reaching proper result.

Reliable, precise, unvarying.

Interchangeable plates permit either 16 or 35 viewing on same unit.

Operates on standard 110 V 60 cycle.

MODEL A — 4200 $ 2,950.00

PRINTER ROBOT

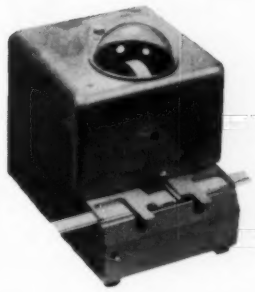
Rapid automatic positioning now possible on your Bell & Howell model D and J printers with the Printer Robot*.
The reader automatically picks up scene exposure information which has been encoded in the 8-hole paper tape by Unicorn's model A 2807 Keyboard-Perforator. Electrical signals thus produced are fed to the computer decoder. These signals are then instantly decoded into tape feed, printer light, or stop information, and relayed to the bi-directional servo mechanism. The printer dial selection lever is automatically moved to a selected light position each time it receives a change pulse from a film notch, magnetic spot or conductor patch.

FEATURES:
More production and accuracy.
Printer light selection lever moved accurately and more quickly than possible manually.
Any light change or all 30 light points handled.
Simple attachment or detachment of the servo unit onto the printer makes conversion complete in a few minutes. Operates on 115 V AC 60 cycle operator model #A 2805.

* Patent Pending

KEYBOARD-PERFORATOR
MODEL A2807 $2,200

PRINTER ROBOT
MODEL A2805
$3,500



TAPE SPLICER

Film splicing now assuring safe passage through processing.

Automatic operation — ideal for total darkness.

Pressure sensitive mylar base tape wraps completely around the cut film.

Edges tied down eliminates possibility of film catching in processing.

Thin, yet strong splice.
800 splices per roll of tape.

MODEL A - 2835 - 35mm $2,200.00
MODEL A - 2816 - 16mm $2,200.00
(MODEL A - 2870 - 70mm $2,700.00
Special order)

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precision film editing equipment

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WEDNESDAY—APRIL 23

9:00 LABORATORY PRACTICE

Traveling-Matte Process With Infrared
BERNARD LEONARD PICKLEY, *Hollywood*
Recent developments in dichroic coatings have made practical an effective method of producing traveling mattes using infrared techniques. The equipment, materials and methods are described.

A Professional 35mm Review Room
R. L. ESTES, *Eastman Kodak Co., Rochester, N.Y.*
A professional 35mm motion-picture review room is described wherein the variables of screen brightness, light distribution, and color temperature of the screen light are carefully controlled. Dual projection of two pictures side-by-side on the same screen requires arc lamps with automatic optical positioning of the carbons, selsyn interlock motors on each projector, and remote focusing controls on the projection lenses. The methods used to minimize flicker and control ambient illumination are discussed along with elements of room design, choice of screens, and mechanical equipment.

Motion-Picture Laboratory Projection Facilities for Servicing Television Film Programs
DON V. KLOEPFEL, *General Film Laboratories Corp., Hollywood*
Adequate viewing facilities are essential to quality control in a modern film laboratory. Facilities designed for viewing product for motion-picture screen use must be increased and supplemented before they can be used to view properly and inspect film intended for TV presentation. This paper describes such facilities as provided by General Film Laboratories.

Economic Aspects of Television Film Production in Color
SIDNEY P. SOLOW and LEWIS MANSFIELD, *Consolidated Film Industries, Hollywood*
This paper represents a survey made to determine the factors of increased costs affecting present-day TV film production in color as compared with black-and-white.

An Improved Professional 16mm Reversal Color Camera Film
N. H. GROET, M. M. LIBERMAN and F. A. RICHEY, *Kodak Research Laboratories, Eastman Kodak Co., Rochester, N.Y.*
A subtractive reversal color film with incorporated couplers has been designed to provide high-quality originals for the production of release prints. This paper is primarily concerned with the film structure, sensitometric characteristics, exposure requirements, suggested filters, and the printing behavior of this film. A demonstration will follow the companion paper on this film. This film is designated Ektachrome Commercial Film, Type 7255 (16mm).

The Processing of an Improved Professional 16mm Reversal Color Camera Film
DEANE S. THOMAS, JR., HOWARD W. VOGT, and HERBERT L. REES, *Color Technology Div., Eastman Kodak Co., Rochester, N.Y.*
The processing of Ektachrome Commercial Film, Type 7255 (16mm), in Process ECO-1 is described in some detail. The processing cycle consists of First Developer, First Hardener, Reversal Printing, Color Developer, Second Hardener, Ferricyanide Bleach, Fixing Bath, and Stabilizing Bath, with water washes following each bath except Bleach and Stabilizer. Tank and replenisher formulas, important control factors, processing equipment, and necessary precautions or successful processing are discussed. The Eastman Kodak Co. will process this product on the same facilities and at the same laboratories now used for Kodachrome Commercial Film, Type 5268, which the new film is designed to replace. Ektachrome Commercial Film may also be processed by the user if desired.

WEDNESDAY AFTERNOON

1:15 LABORATORY FACILITIES

Ultrasonic Cleaning of Motion-Picture Films and Magnetic Tapes
ROBERT P. GUTTERMAN, *General Kinetics Inc., Arlington, Va.*
Ultrasonic energy in a solvent bath has been applied successfully to cleaning motion-picture negatives and magnetic tapes. Full realization of the process potentialities is accomplished with a special drying device which prevents redeposition of removed soils. Self-contained machines have been designed and built for both special purpose and general laboratory use.

A Powered Film-Cleaning Drum
HARRY BRUEGGEMANN, *Pathe Laboratories, Inc., Los Angeles*
After trying many devices and systems, Pathe Laboratories in Hollywood has decided that hand cleaning on a drum produces the cleanest possible film. Unfortunately, this is also the most expensive technique; therefore, in building our latest drum, we have tried to make the operation as efficient as possible. The drum has a low turning moment, is motor-driven forward and reverse, has a solenoid brake, and the drive and brake can be disengaged for hand turning.

Dirt-Free Exhaust Hood for Cleaning Film
HOWARD F. OTT, *Color Technology Div., Eastman Kodak Co., Rochester, N.Y.*
Motion-picture film is usually cleaned with materials that require the use of an exhaust hood to prevent any hazard to the operator. In the usual exhaust hood there is a steady influx of air carrying airborne dirt, some of which settles on the film just cleaned. A dust-free exhaust hood has been developed which utilizes a curtain of filtered air to prevent the entrance of airborne dirt.

We'll be there!

Visit us at booth 216-218 and see the latest in professional equipment

George Oakley
Jim Wassell
Hans Wohlrab

PROFESSIONAL EQUIPMENT DIVISION Bell & Howell

INSTRUMENTATION CAMERA

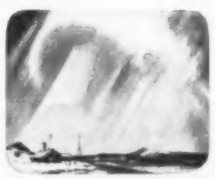
The Perfect Answer to Film Recording

HERE is the perfect answer to the problems of film recording. The Mark 7 Instrumentation Camera is completely-flexible through the entire field of instrumentation and aerial survey positioning photography. The shutter is a focal plane type, the basic exposure speed of which is 1/100 second. The camera may be cycled from 3 frames per second to any desired longer interval. Interchangeable apertures permit photographs of 18x25, 25x25 or 25x36 mm. A high degree of accuracy is achieved in respect to lens alignment, focusing and format positioning. Main components designed on the "module" system make conversion from one camera type to another relatively simple should customer requirements change. Write for literature and quotations.

SPECIFICATIONS

INSTRUMENTATION CAMERA TYPE T232 Mk7

Size:	7¼" x 5⅞" x 6½"
Weight:	13½ lbs.
Power:	28 volts DC; constant demand, .4 amperes; intermittent up to 1.8 amperes. The Type T232 DC power supply, which operates from 110v 60 cps, is available to power the camera
Lens:	28mm Augenieux F3.5, or to customer specification
Magazine:	100 ft. 35mm standard sprocketed film, No. 10 daylight loading spool. 400 ft. magazine available on special order
Picture Formats:	18x25, 25x25 or 25x36 mm.
Exposure:	1/100 second, or longer with intervalometer control
Interval Time:	3 cycles per second maximum



Canadian Applied Research Limited

(formerly PSC Applied Research Limited)

1500 O'CONNOR DRIVE
TORONTO 16, ONTARIO, CANADA
PLYMOUTH 5-3371

MEMBER: A. V. ROE CANADA LIMITED & HAWKER SIDDELEY GROUP

A Color Timing Calculating Machine
G. T. KEENE, A. J. SANT and J. D. CLIFFORD, *Color Technology Div., Eastman Kodak Co., Rochester, N.Y.*
In a previous paper, to appear in an early issue of the *Journal*, a system was described in which a slide-rule type calculator was used to predict subtractive printer balances In the present paper, the equations for the slide rule have been incorporated into a machine calculator based on the Wheatstone bridge principle. This machine will present printing information directly from negative density input data. It may be used for either subtractive or additive printing and can utilize either gray card or integrated full-frame negative density information. The timing accuracy is ±0.03 log E for the first print relative to the standard print for the system in use. Motion-picture prints are available to illustrate the timing of a 700-ft test roll.

Variable-Speed Printing
IRWIN A. MOON and LEWIS H. HUMPHREY, *Moody Institute of Science, Los Angeles*
By keeping the lamp voltage constant it is possible to compensate for varying filter factors, lamp aging, overall negative density, etc., by varying the speed of the printer. In this way it is possible on a single light negative to always print at light 22 and the maximum possible speed thus effecting greater savings in printing time.

An Automatic Shutter for Motion-Picture Printing Machines
THEODORE W. BATTERMAN and MATHEW POBOG, *Electronic Systems of Illinois, Inc., Chicago*
A device has been designed to meet the exacting requirements of the laboratory in obtaining high-quality prints with increased productivity. The unit replaces present hand-operated shutters and converts a printer for fully automatic operation. The inherent problems considered are overshoot, or bounce, manual performance and repeatability of manually operated shutters, especially evident when short scene changes are desired at increased printer speeds. The shutter operates from either of two different types of control systems: programming board or punch tape with new dial perforator. It is small in size and designed for ready installation on machines of several manufacturers.

A Two-Speed Drive for Continuous Motion-Picture Printers
JOHN J. GRAHAM and HOWARD F. OTT, *Color Technology Div., Eastman Kodak Co., Rochester, N.Y.*
In this two-speed drive, which was adapted to a Bell & Howell Printer, Model D, two motors drive two electrical clutches that are mounted on the same shaft. The two motors running continuously, drive two pulleys in the same direction, one at approximately twice the speed of the other. The armatures of the clutches are splined to the hub of a third pulley that drives the printer. An electrical circuit triggered by a cuing system activates one clutch or the other to change the speed of the printer within a short enough interval so that there is no loss in projection quality of the print. Operation speeds of 100- and 200-ft/min, 60- and 120-ft/min, and 30- and 60-ft/min have been used. Such a speed changer would permit optimum productivity on a printer using negatives containing scenes of widely varying densities.

A Subtractive Color Printer With a Geneva Scene-Change Mechanism
HARRY BRUEGGEMANN, *Pathe Laboratories, Inc., Los Angeles*
At the present state of the art, the scene-change system of a subtractive color printer can be made very reliable as compared to an additive printer. This paper describes a scene-change system which uses a Geneva movement to turn a sprocket, which in turn moves a color filter scene-change matte. The action transports the matte smoothly and reliably.

A Film-Processing Machine of Flexible Design
IRWIN A. MOON, *Moody Institute of Science, Los Angeles*
A combination 16/35mm, black-and-white and color processing machine has been constructed at Moody Institute of Science. Unconventional features include individual torque motor drive on each shaft, the lack of full-shaft elevators, novel recirculation and constant-tension systems, automatic "pile-up" and "break" controls and the use of plastic materials throughout.

A 16/35mm Daylight Film Processing Machine
STANLEY GEORGE FITCH, *Newman & Guardia Ltd., Harlow, Essex*
After a brief introduction, a 16mm sound film describes in detail the design and operation of the Lawley Junior 16/35mm daylight film processing machine. Lantern slides illustrate performance and characteristics of film stocks and processing solutions when combined in the processor.

WEDNESDAY EVENING

6:45 Cocktail Party

8:00 BANQUET AND DANCE

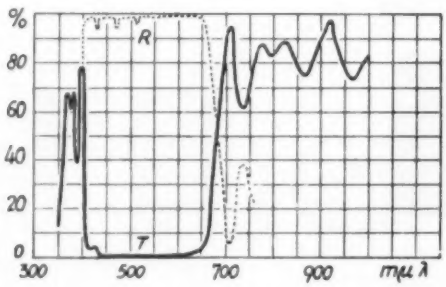
BALZERS

COLD MIRRORS

FOR PROJECTION MACHINES AND SPOTLAMPS

Less heat, more light

WITH LAYERS MORE RESISTANT THAN THE GLASS ITSELF



Nearly 100% reflection. — No heat problems, even in the most powerful illuminating systems today available — On account of the high melting point coatings are more durable against mechanical and chemical attacks than glass. We coat also your own blancs up to 24 in. diameter at less than $ 100.— per piece.

Write for sample pieces today.

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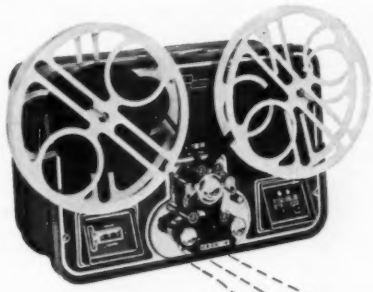
PRINCIPALITY OF LIECHTENSTEIN (SWISS CUSTOMS AREA)

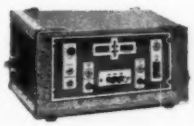
R. M. LYNN, P.O. BOX 745, ARCADIA, CALIF.

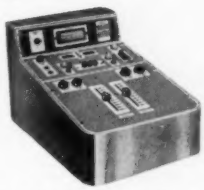
MAGNASYNC MARK IX

MAGNAPHONIC SOUND SYSTEM



The classic Mark IX film transport features superb engineering and design. The rugged, lightweight dural enclosure is designed to provide exceptional serviceability. The Mark IX is fully remote-operated, push-button controlled. Highest quality plug-in amplifier components are incorporated.





MARK IX, SYSTEM 1

Includes Mark IX and remote control for use with any quality speech input system; push-button motor controls, synchronous remote footage counter, Record-Play switch and Film-Direct monitor switch.

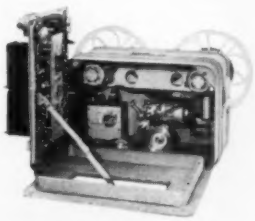
MARK IX, SYSTEM 2

Includes Mark IX and the popular Magnasync Model G-924 microphone mixer with remote control assembly in matching case. The three units hasp together to form a single carrying case.

MARK IX, SYSTEM 3

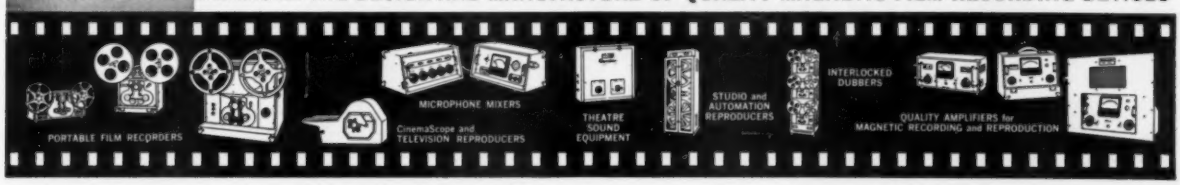
Includes Mark IX and the new Magnasync Model G-932 slide-wire attenuator microphone mixer with built-in remote control assembly. Optional portable enclosure matches Mark IX recorder

Available in
16mm, 17½mm and 35mm



Rear view of Mark IX showing the complete accessability to all plug-in miniature components.

INTERNATIONAL LEADERS IN THE DESIGN AND MANUFACTURE OF QUALITY MAGNETIC FILM RECORDING DEVICES



MAGNASYNC MANUFACTURING CO., LTD., 5546 Satsuma Ave., North Hollywood 2, Calif.

MAGNASYNC Magnaphonic SOUND SYSTEM

DEALERS

NEW YORK: Camera Equipment Co., 315 W. 43rd St., New York 36, N.Y.; JUdson 6-1420; Cable "CINEQUIP."
CHICAGO: Zenith Cinema Service, Inc., 3252 Foster Ave., Chicago 25, Ill.; IRving 8-2104.
SAN FRANCISCO: Brooks Camera Co., 45 Kearney, San Francisco, Calif.; EXbrook 2-7348.
LOS ANGELES: Bims & Sawyer Cine Equipment, 8940 Santa Monica Blvd., Los Angeles 46, Calif.; OLympia 2-1130.
INDIA: Kine Engineers, 17 New Queens Road, Bombay, India.
JAPAN: J. Osawa & Co., Ltd., 5 Ginza Nishi 2-Chome, Chuo-Ku, Tokyo, Japan; Tel: Tokyo 56-8351-5; Cable "OSAWACO."

THURSDAY—APRIL 24

9:00 GENERAL SESSION

16mm Automatic Film Splicer
HARRY TEITELBAUM, *Hollywood Film Co., Hollywood*
The machine has been designed to repair and/or butt-splice all types of 16mm motion-picture film including acetate, Cronar or nitrate base with the aid of a special Mylar transparent tape, perforated to match the film to be spliced and coated on one side with a pressure adhesive. The tape is precut and rolled onto the film automatically from a precision sprocket.

Easy Editor
HARRY TEITELBAUM, *Hollywood Film Co., Hollywood*
Sound effects and music film editors normally work with five to six reels mounted on long-shaft, hand rewinds with an end support. Removing any of the reels becomes a cumbersome job and one that is no longer necessary as a result of the new Easy Editor which drives any or all of the reels through friction and permits the easy withdrawal of any reel without disturbing the others. In addition, a braking method on either side permits the operator to hold the film on any of the reels taut in spite of the fact that some reels may be larger or smaller than others.

Improved Television Viewfinder for Motion-Picture Production
KARL FREUND, *Photo Research Corp., Hollywood*
This paper describes a low-cost TV viewfinder using a 1-in. vidicon with 600 lines resolution. The miniature viewfinder is a further development of a viewfinder exhibited at the 80th Convention at Hollywood which used a ½-in. vidicon with 300 lines resolution. The new viewfinder, which eliminates previously used optical systems, will enable a motion-picture director to see the picture on a TV monitor, thus assisting him to make decisions regarding re-takes. Use of the viewfinder is expected to result in considerable savings in motion-picture production.

A Method of Measuring the Steadiness of Motion-Picture Cameras
A. C. ROBERTSON, *Eastman Kodak Co., Rochester, N.Y.*
The unsteadiness of cameras can be evaluated by a double-exposure technique using a "step-wedge" shaped object for the first target and a simple bar for the second. The results are obtained in the form of individual, whole values; hence simple counting methods are used in analyzing the data rather than complicated measuring equipment and consequently there is less fatigue for the observer. The action of some cameras is described, and their errors analyzed by the use of this technique.

Colorvision: A New Additive Color System for Motion-Picture Photography
LIONEL H. WHEELER, *Colorvision, Inc., Los Angeles*
Photographic fields in which an additive color system is desirable are examined, as are also applications to color television and Armed Forces instrumentation photography. The problems of an operational additive color system are outlined and the solution to these problems is related to the Colorvision camera, printing and projection equipment. The technique of making subtractive prints from an additive negative is described.

16mm Super Anscochrome Films
JOHN L. FORREST, *Ansco, Binghamton, N. Y.*
16mm Super Anscochrome Daylight Type 225 was introduced in 1957 followed by Super Anscochrome Tungsten Type 226 in early 1958. Both films have an exposure index of 100 with normal processing. This high speed now makes possible the production of motion pictures in full color which previously was not possible. The films are described and their uses illustrated.

THURSDAY AFTERNOON

1:30 PRODUCTION PROBLEMS

Design of Flexible Portable Power Equipment for Motion-Picture and Television Locations
M. A. HANKINS and PETER MOLE, *Mole-Richardson Co., Hollywood*
The amount of lighting power required for motion-picture and TV locations varies over a wide range from one site to another. Portable engine-generator sets have been developed which may be used singly or in multiple to supply economically the peak power demand of any particular location. These portable power plants together with recent developments in flexible transporting equipment can accommodate the required combinations of the power plants and their fuel supply.

Soil Removal Problems in Wardrobe Cleaning
HERBERT MEYER and GEORGE SOYKA, *Motion Picture Research Council, Hollywood*
Special cleaning methods are required for clothes worn during a motion-picture production. Removal of "cosmetic dirt" presents a cleaning problem that cannot be solved by use of ordinary cleaning methods. In addition to soil removal requirements, speed is essential. Frequently a wardrobe must be cleaned overnight. Methods devised to meet these requirements are described.

SMPTE now has available 35mm and 16mm color television test films and slides designed for TV station use under specifications set up by the SMPTE Television Committee—representing the quality of color material obtainable from Ansco, Technicolor and Eastman prints.

☐ The picture-only films have three sections of five scenes each.

☐ Gray scale at start of first scene can be used in set-up or for adjusting signal generating equipment so that the chrominance subcarrier vanishes with given set-up.

☐ Same high quality picture material in both films and slides.

☐ Slides include one black-and-white chart of the alignment and resolution target used in standard television test films.

☐ All scenes illuminated for shooting with a lighting ratio of approximately 2:1; i.e. key light was twice fill light, measured in foot candles.

35mm Color TV Test Film—approx. 700 ft.
16mm Color TV Test Film—approx. 280 ft.
Set of 6 2 x 2 in. Slides

SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS
55 West 42nd Street, New York 36 Tel: LOngacre 5-0172

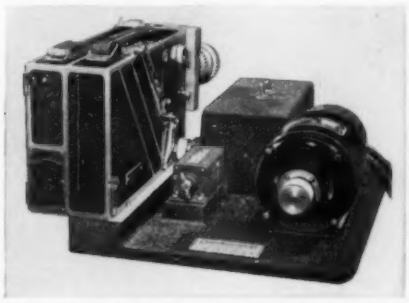
When you can't budge from the Budget... see CECO!

Bell & Howell Continuous Film Printer

Prints either sound or picture by contact. Suction-cooled lamphouse; removable filter holders; 300 watt projection type lamp. Other B & H Models and accessories available. **$4,600.00**

Other Printers from **$167.50**

When you make commercial films, the budget is sacred. It isn't like the old days in Hollywood when a big name director could go a couple of million over his budget—and get away with it. Today if you exceed your budget, it very likely will come out of your own pocket. So do what other smart producers, directors, cameramen and sound engineers do. Consult CECO. *Our experts have the know-how about equipment and money-saving techniques. We carry the world's largest assortment of professional cameras, lenses, tripods, recording, editing, lighting, laboratory and processing equipment, etc. There is never any charge at* CECO *for consultation. Come by for help with any problem, large or small.*



CECO Stop Motion Motor for Cine Special

110 volt AC operation; ½ second exposure. Has forward, reverse, on-off switches; frame counter; power cable. Attaches easily to camera without special tools. **$450.00**

Bowids Animation Disc and Peg Bar

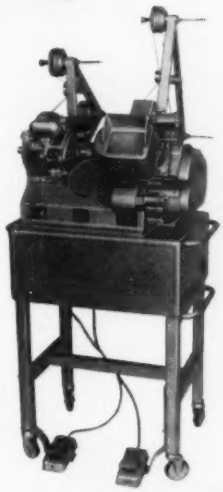
Animation Disc features oversize contoured glass; convenient rotation; positive lock; full vision sliding scale; and clear, opal, or frosted glass. Peg Bar has precision pegs so that cels slip on and off easily. Has countersunk holes and flush screws for easy attaching.

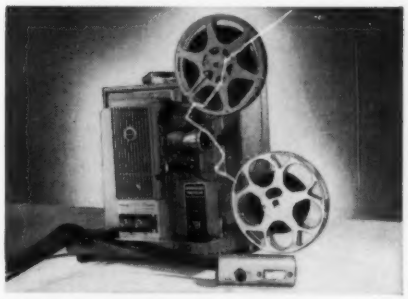
Animation Disc **$47.50**
Peg Bar **6.50**

Moviola Film Editing Machine "Series 20"

Designed so that short pieces can be used without putting film on reels. Rear projection screen. Reversed by hand-operation switches. Other models and Rewinders, Synchronizers, and Sound Readers available.
Model UD20S (Illustrated) **$1,925.00**

Other Film Editing Viewers from **$49.50**





Weinberg-Watson Modified Version of Kodak Analyst

Gives flicker-free projection at speeds from 6 to 20 frames per second. Single frame operation forward and reverse without damaging film. Quick transition from continuous to single frame. **$795.00**

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CAMERA EQUIPMENT CO., INC.

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3:00 PHOTOGRAPHIC TELEVISION RECORDINGS

16mm Color Kinerecording for Theater Projection

LEWIS R. BLAIR and LOUIS BEHRMANN, *Walter Reed Army Medical Center, Washington, D.C.*

The ability to secure high-quality 16mm original color film of telecasts displayed upon a trinescope has provided the means whereby professional medical telecasts can be distributed as projection prints at a fraction of the cost of films produced by any other method. Cameras, trinescope, and magnetic film recorders have been assembled in such a manner as to permit operation by one person and to provide cuing, clapsticking, and titling in addition to continuous recording.

High-Fidelity Video Recording Using Ultrasonic Light Modulation

LEO LEVI, *Defense Products Div., Fairchild Camera & Instrument Corp., Syosset, N.Y.*

The method makes it possible to record on photographic materials electronic signals at video frequencies. Employing the modulation of light intensity by ultrasonic waves, the system is capable of resolution and dynamic range performance well in excess of those attained with conventional methods. Both black-and-white and color modulation of light are possible. Ultrasonic light modulation has been successfully employed to obtain high-quality radar information, and it is inherently capable of providing a similar function in video recording — either field-by-field or continuous.

The Bryg System of Photographic Color Projection for Television

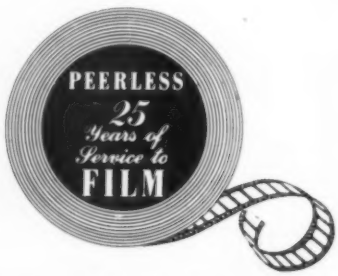
ADOLPH RAZDOW, *Bryg, Inc., Butler, Pa.*

The human eye has higher acuity for luminance (black-and-white) vision than for chrominance (color). This concept, applied to color television, permits gray-scale registration on panchromatic film (high resolution black-and-white large-size image; two low-resolution small-size images, filtered red and blue). Three images are transmitted through three pickup tubes with electronic matrixing providing green information. Automatic electronic references control transfer characteristics and gammas. Shrinkage and registration problems are analyzed.

Steadiness and Image Structure of Televised Motion-Pictures

D. F. LYMAN, *Apparatus and Optical Div., Eastman Kodak Co., Rochester, N.Y.*

If realistic motion pictures are to be produced on TV viewing screens, it is essential that recording cameras and TV projectors be of high quality with respect to the steadiness and image structure of the picture. Several mechanical improvements have been made in pulldowns and sprockets. New analyzing fixtures and methods contributed to these advances. An examination of prints from various laboratories shows the importance of providing good steadiness and definition in the original material.



Torn sprocket holes...
film breaks...
splices opening up...
picture in and out of focus

Such conditions are
often due to brittleness,
buckle, curl, shrinkage

Peerless Reconditioning

can repair the damage
and correct conditions
that may have caused it.

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THURSDAY EVENING

7:45 MAGNETIC TELEVISION RECORDINGS

Engineering Planning in the Evolutionary Development of the Video-Tape Recorder

JOHN M. LESLIE, JR., *Ampex Corp., Redwood City, Calif.*

There is a planned evolutionary process which is currently unfolding through an integrated engineering program surrounding the Ampex VR-1000 Video Tape Recorder. The full story on this program and its implications in TV broadcasting is covered here and in the papers immediately following. The questions to be answered include: (1) Will present production machines be obsoleted by developments of the immediate future? (2) How much will video head assemblies cost the user? (3) Exactly what procedures will be followed for editing of video-tape recordings? (4) How is the monochrome VR-1000 expanded to color with the prototype color conversion assembly? (5) What is needed in monochrome and color video tape recorders to handle special effects? (6) How will full interchangeability of tapes among video-tape recorders be accomplished without sacrifice of picture quality?

Electronic Marking and Control for Rapid Location of Vertical Blanking Area for Editing Video-Tape Recordings

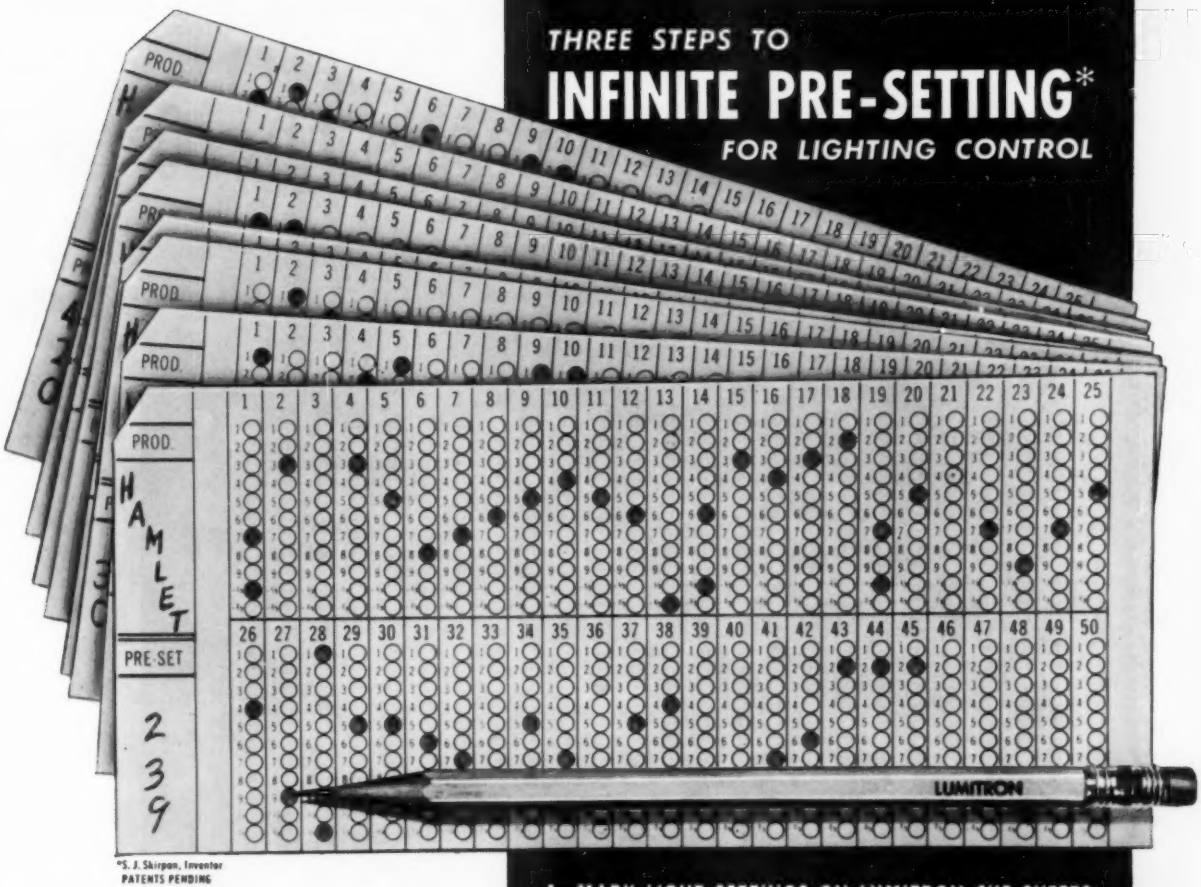
JOSEPH ROIZEN, *Ampex Corp., Redwaod City, Calif.*

In the interim between prototype and the production VR-1000 Video Tape recorders now being delivered, Ampex Corp. has developed a relatively simple and inexpensive method for splicing video tape. This achievement required an extensive investigation of three problems: the visual "development" of the magnetic image on the tape, the accurate positioning of the splice in relation to the small mechanical tolerances within which the splice must be placed, and methods of joining tapes to achieve maximum mechanical strength with minimum effect on the head assembly. Electronics have been included in production VTR's to provide accurately spaced "edit" pulses to position the splice. Simplified tray or spray "development" methods have been attained. The inherent characteristics of the equipment make video editing and sound dubbing relatively simple. The dubbing of sound may be accomplished using standard studio techniques for handling audio. The versatility of the video-tape recorder is tremendously enhanced by the ability of the broadcaster, agency or film studio to splice in pre-recorded commercials or any combination of tape segments from other sources for smooth program continuity.

Electronic Conversion to Color Recording With the Ampex VR-1000 Video Tape Recorder

CHARLES E. ANDERSON, *Ampex Corp., Redwood City, Calif.*

Following the development of a practical system for monochrome television recording on magnetic tape, the logical direction for further refinement was toward a system capable of recording color.



THREE STEPS TO

INFINITE PRE-SETTING*

FOR LIGHTING CONTROL

*S. J. Skirpan, Inventor
PATENTS PENDING

1. MARK LIGHT SETTINGS ON LUMITRON CUE SHEETS
2. STACK CUE SHEETS IN CONSOLE READERS
3. CROSS-FADE SMOOTHLY FROM ONE PRE-SET TO THE NEXT WITH MANUAL FADER

IT'S AS SIMPLE AS 1, 2, 3! . . . *the all-electronic, all-new* LUMITRON INFINITE PRE-SET LIGHTING CONTROL SYSTEM. Far superior to anything now available, it eliminates guessing, cue translation and human error to permit the *prompt* accomplishment of the desired lighting design. Every cue is *electronically interpreted* and *always* explicitly followed. The tubeless *LUMITRON* System provides an *infinite* number of Pre-sets for the swift achievement of the finest, most complex lighting designs . . . and frees the Lighting Designer from routine tasks.

Here, in a compact, table-sized Console, is the most revolutionary concept of stage lighting control yet devised.

CHECK THESE ADVANTAGES:

- UNLIMITED NUMBER OF PRE-SETS AVAILABLE TO THE LIGHTING DESIGNER
- PROVIDES AN ALTERABLE OR PERMANENT RECORD OF THE LIGHTING PLOT OF EVERY SHOW
- ABSOLUTE SIMPLICITY OF OPERATION
- AUTOMATIC, YET ALWAYS UNDER THE CONTROL OF THE OPERATOR
- NO TUBES — NOTHING TO WEAR OUT — LOW MAINTENANCE
- COMPETITIVELY PRICED WITH SYSTEMS LIMITED TO ONLY TEN PRE-SETS
- FULLY GUARANTEED—INSTALLED AND MAINTAINED BY EXPERT LUMITRON ENGINEERS

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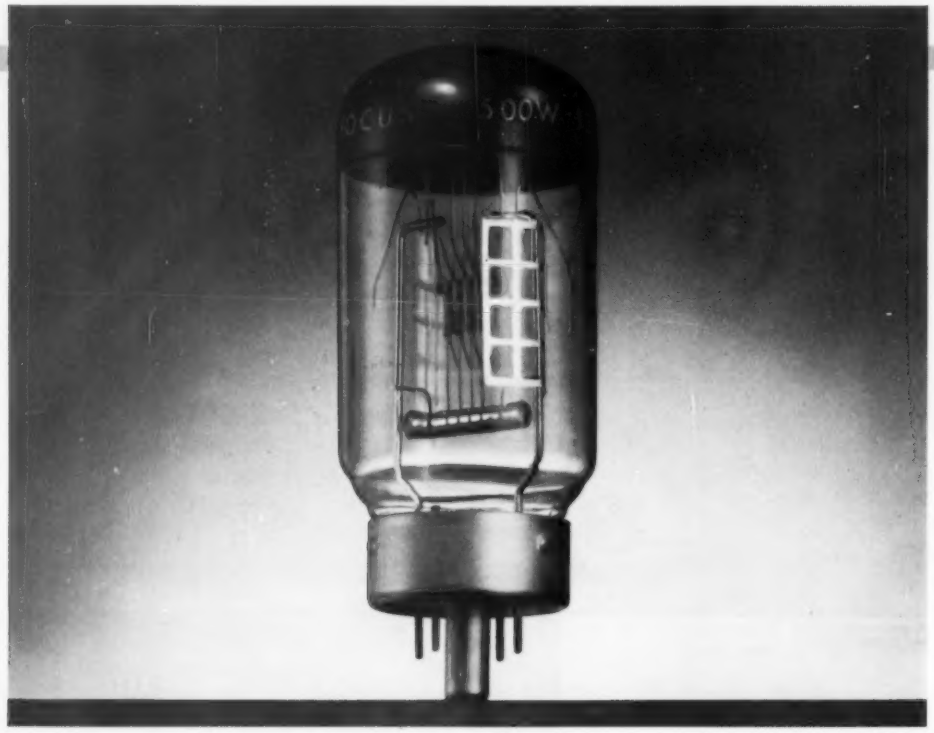

FIRST—The famous TRU-FOCUS projection lamp!

FIRST lamp made with precise pre-focusing through automation.

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FIRST lamp designed for horizontal and vertical burning.

FIRST with simple, positive snap-in lamp socket assembly.

FIRST to reduce overall size of projector lamp and socket.

FIRST line of pressurized lamps for higher brightness, longer life.

FIRST with positive wiping contacts for lower power loss.

FIRST lamp design compatible with modern projector styling concepts.

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Here are some of the leading manufacturers now using the revolutionary Sylvania TRU-FOCUS projection lamp:

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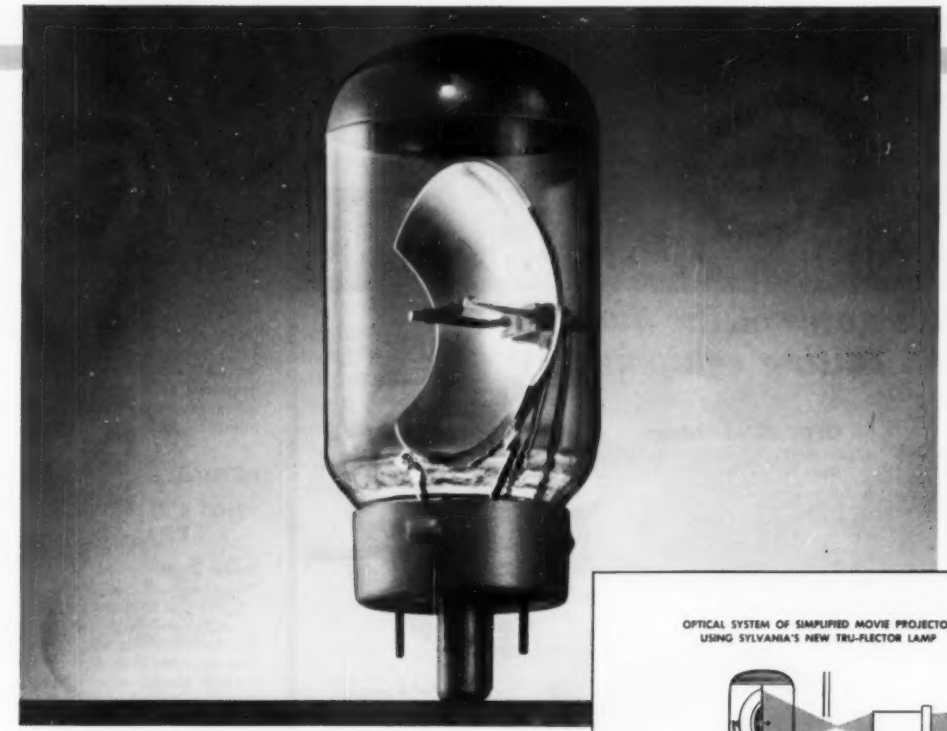
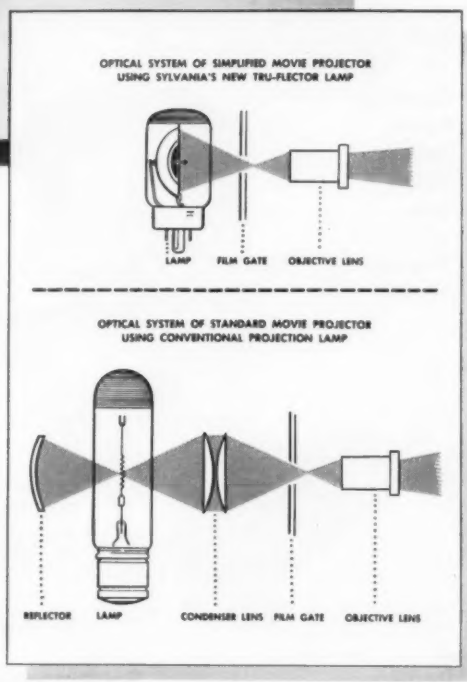
QUICK-SET

of the projector industry!





NOW—the revolutionary TRU-FLECTOR projection lamp!

Now—a lamp with "internal optics."

Now—a lamp that eliminates reflector and condenser systems.

Now—a 150-watt lamp with performance comparable to a 500-watt lamp.

Now—a lamp that makes possible smaller, cooler, brighter, more compact 8mm. projectors.

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The successful development of such a system, in the form of a color conversion accessory which connects to the Ampex VR-1000 Video Tape Recorder, is described here, with the operational theory of the accessory discussed fully.

Timing and Frequency Requirements for Color Video-Tape Recording
EARL ROGER HIBBARD, *Ampex Corp., Redwood City, Calif.*
The development of the video-tape recording system in widespread use today was aimed primarily at fulfilling the immediate need for recording monochrome TV programs. In extending the techniques necessary to record color, improvements were needed in two general areas: in timing performance in the basic electromechanical system and the extension and control of frequency response in accordance with the stringent requirements imposed by the NTSC color system. A description of the options available for the solution of these problems and an account of the technical reasons behind the choices made are given here.

Interchangeability of Color Video-Tape Recordings
CHARLES P. GINSBURG, *Ampex Corp., Redwood City, Calif.*
The rigid tolerances characteristic of the NTSC color system, in regard to time-base stability and bandpass characteristics, make the problem of interchangeability of color TV programs recorded on magnetic tape considerably more difficult than with monochrome programs. The broadcast industry demand a color VTR system capable of maintaining maximum quality on an interchangeable basis. The engineering problems imposed by these requirements are fully discussed here.

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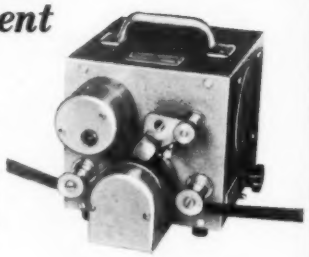
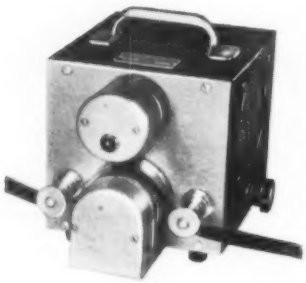
OPTICAL-MAGNETIC
Model 800 RL, 16mm, 35mm and ¼" tape. NET PRICE $269.50

Sound track is read by placing it towards the operator and reading from Right to Left. (May also be used from Left to Right.) FEATURES: Simple threading; SMPTE Standard machined film rollers with oilless bearings; precision ground shafts; polished stabilizer



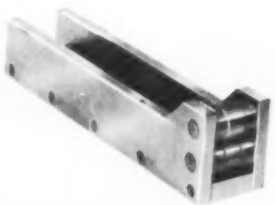
Complete Sound Reader Guide Free on Request



OPTICAL
Model 600 RL, 16mm and 35mm. Net Price $195.00

drum with needle bearings (surface cannot damage film). Dimensions 6" x 6" x 8½". AMPLIFIERS: 117-volt, 60 cycle AC; 4-watt power output; heavy-duty Alnico V speaker; safety fused; prefocused socket; pilot light; 6' heavy-duty cord.

WRITE FOR LITERATURE



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Magnetic-Tape Recording of Color Television Signals
JEROME L. GREVER, *Broadcast and Television Dept., Radio Corp. of America, Camden, N.J.*
The technique of recording television signals on 2-in. wide magnetic tape by high-speed transverse scanning of the tape has been extended to include the recording of color television signals. This development encountered a number of interesting and challenging problems. The paper describes some of the precise signal-handling techniques and special equipment that had to be developed in order to build a broadcast quality video-tape recorder capable of both color and monochrome TV recording.

FRIDAY—APRIL 25

9:00 PLASTICS FOR THE MOTION-PICTURE AND TELEVISION INDUSTRIES

A Symposium on Use of Plastics in Motion-Picture Production
Presented as a joint effort by SPE and SMPTE, HERBERT MEYER, *Chairman*
1. Plastics for use in motion-picture laboratories; materials of construction for photographic processing equipment. 2. Plastics for use in set construction: (a) casting resins, structural materials, ornamental and functional coatings, vacuum heat forming materials and processes, foamed plastics, flexible sheets; (b) a paper on properties of principal polymers; (c) prepared questionnaire answered by panel; (d) questions from the floor answered by panel.

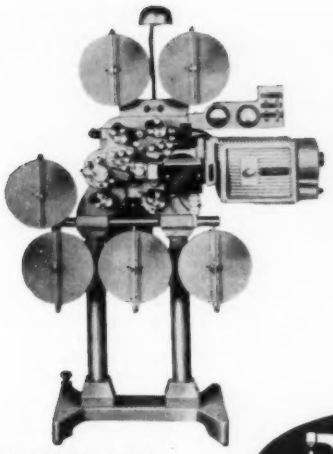
FRIDAY AFTERNOON

2:00 TELEVISION STUDIO PRACTICES

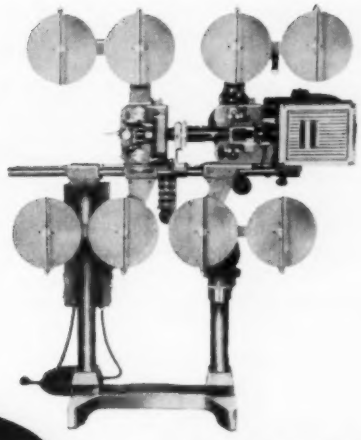
Studio Lighting and Production Facilities
WILLIAM R. NEEDS, *WPST-TV;* and GEORGE GILL, *Century Lighting, Inc., Southern Branch, Miami, Fla.*
To obtain the best studio lighting in the limited time available in an active studio, a lighting and curtain system was designed and installed. Lighting results have been improved and lighting time has been minimized. Two groups of rails are used so that lights can be quickly located wherever desired. Once set, control of the lights for each scheduled show is handled at the production control console. The installation has proven very flexible and completely adequate for our needs. Its principles are applicable in studios of any size.

Television Lighting Facilities for Black-and-White Today — Color Tomorrow
LOUIS ERHARDT, *Century Lighting Inc., Santa Monica, Calif.*
To anticipate the added requirements for color TV in both the amount of light and its control, certain improvements in equipment and refinements in control are discussed. An integrated control system is proposed for complete programming of lighting requirements with the minimum capital equipment to produce a maximum of control opportunity. The plan enables a studio to determine its own requirement consistent with its scale of operation.

"Preset Reloading": A New Approach to Television Lighting Control
WILLIAM M. RICHES, *CBS Television City, Hollywood*
The Preset Reloading System has been developed by CBS Television, Hollywood, to solve the problem of higher dimmer loading and greater numbers of dimmers required by color television, and to eliminate the need for physical repatching of load cords during broadcast. Through the use of this low-voltage preset programming system the lighting loads from different scenes may be switched as a group, at any time, to any preselected group of dimmers, thus re-using the dimmers many times during a broadcast.



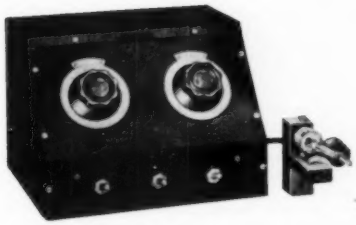
PETERSON CONTINUOUS DOUBLE-HEAD
MODEL 16-C-60-16MM
MODEL 35-C-60-35MM



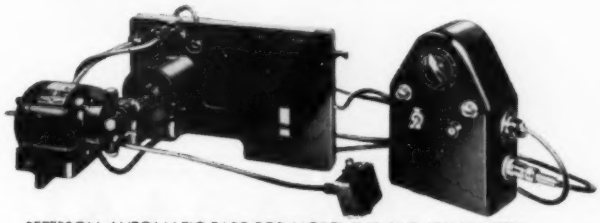
PETERSON OPTICAL PRINTER MODEL 300

PeterseN

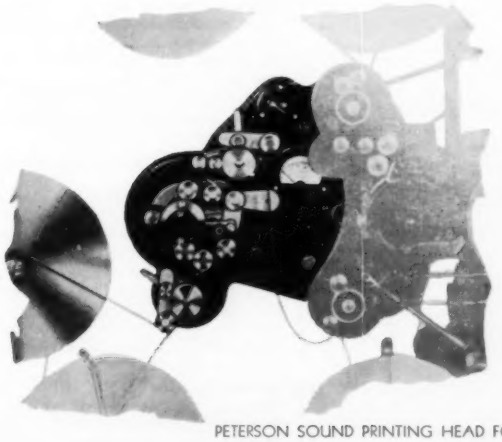
Precision Motion Picture Printing Equipment and Accessories



PETERSON ELECTRONIC CUEING SYSTEM FOR ALL PRINTERS



PETERSON AUTOMATIC FADE FOR MODEL "J" AND "D" PRINTERS



PETERSON SOUND PRINTING HEAD FOR MODEL "D" AND "J" PRINTERS

MOTION PICTURE PRINTING EQUIPMENT CO.
Mfrs. of Optical and Continuous Printers and Accessories
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Television Camera Lenses
GORDON HENRY COOK, *Taylor, Taylor & Hobson, Ltd., Leicester, England*
Lenses intended for use on vidicon-type TV cameras must have wide relative aperture, uniformity of illumination throughout the picture area and yield the type of performance demanded by TV transmission channels. The picture format is larger than that utilized in 16mm film cameras and the aberrational effects of the tube end glass thickness are perceptible. The paper discusses the suitability of standard cinematographic lenses under these conditions of use and describes a new range of lenses designed specifically for this purpose.

A New Series of Vidicon Camera Lenses
JOHN D. HAYES, *Bausch & Lomb Optical Co., Rochester, N.Y.*
The continued growth of the vidicon type of pickup camera in both the industrial and studio television fields has dictated the development of new camera lenses designed to fulfill the requirements of these applications. The series of lenses to be described has been especially developed to provide a high degree of illumination throughout the entire field as well as an excellent aberrational correction. Details of these, and other pertinent parameters, are to be discussed.

The Chroma-Key Process of Live TV Composites
FRANK J. GASKINS, *National Broadcasting Co., Burbank, Calif.*
An outline of the basic concepts of color differentiation as contrasted to standard luminance matting is presented. Included also is a brief description of Chroma-Key equipment now in use at NBC together with a discussion of some of the techniques employed in its use.

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FRIDAY EVENING
8:00 DISTRIBUTION OF TV PROGRAMS ON FILM

This session will be held at ABC Television Center, Hollywood. Presentation of the papers will be followed by a guided tour of the network and local film facilities in the new Technical Building.

The Coordinated Effort—A Study of Network Film Programming
FRANK G. RALSTON, Jr., *ABC TV Center, Los Angeles*
TV network film programming is the result of coordinated effort. All departments must work together to get the film image on the home TV screen. Sales, Traffic, Station Clearance, Video Recording, Film Departments, Accounting, Programming and other departments are interdependent in that the flow of information and materials from these departments is essential to successful network film programing.

Operation of a Network Film Exchange
CHARLES E. BUZZARD, *NBC, Hollywood*
Conditions and procedures affecting a network film exchange are analyzed on the basis of: types of recordings, negative and kinescope recording numbers, kinescope recording and film service policies, reference prints, differences in policies in kinescope recordings and film programs, and general shipping procedures.

The Editor's Responsibilities in TV Film Distribution
HENRY J. MILLER, *ABC TV Center, Hollywood*
The differences between the responsibilities of the TV film editor and the motion-picture editor are delineated for these areas: commercial integration; negative show level vs. negative insert rolls for positive insertion; a step-by-step discussion on rerun programming; and how time and cost affect the TV film editor.

Is Standardization in TV Film Possible?
JOHN P. BALLINGER, *Screen Gems, Inc., Los Angeles*
The pros and cons of standardization in the TV film industry are discussed in regard to: production, such as cues, leaders, formats, commercial splits; distribution, such as booking requests and confirmations, transshipment requests and confirmations; and in regard to the handling of prints at the station level, such as procedures of editing, curing, splicing-in of commercials, and the keeping of proper records of shipping and playdates. After assessing the possibility of standardization of certain elements, then the question is what might be accomplished by such standardization.

Prolonging the Life of Motion-Picture Release Prints
ERIC C. JOHNSON, *Eastman Kodak Co., Rochester, N.Y.*
Hundreds of release prints are discarded annually because of needless damage to the film. This fact has received renewed emphasis with the increased use of film in television. This paper outlines proper film handling procedures and techniques starting with the "green" print and the need for film lubrication on through projection, cleaning and inspection.

Panel Discussion
Since no question periods will be scheduled during the presentation of the above group of papers a panel discussion will be held immediately after the last paper.

Introduction to the Tour of the New ABC Film Facilities
WILLIAM W. EDWARDS, *ABC Television Center, Hollywood*
The authors will examine the planning of the various flow patterns and work-area facilities and review the tremendous preliminary investigation and comparison of existing modern installations before the decisions on the present installation were reached. This planning has resulted in the finest TV film facilities available.

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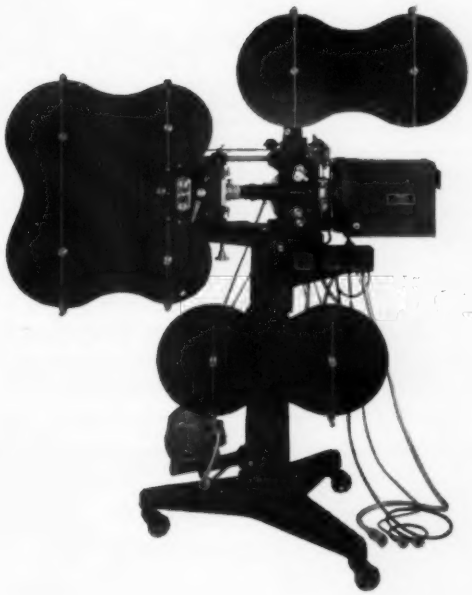

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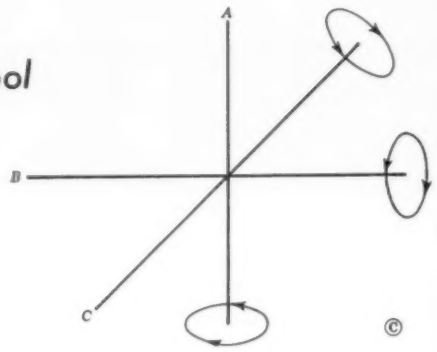

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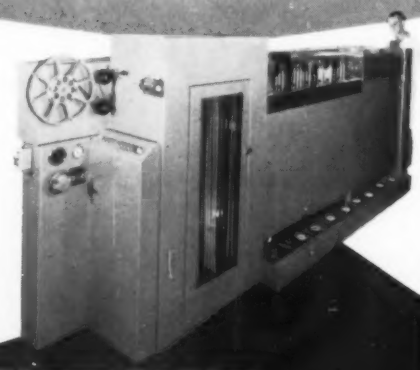

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Education, Industry News

Academy Awards will be presented on March 26, 1958, when winners in each category of artistic and scientific achievement will receive the top award of the motion-picture industry. Competition is keener this year because of the reduction of the number of awards in certain categories, such as Short Subjects Awards which have been reduced from three to two, and Music from three to two.

The Academy also offers special honorary awards in various fields contributing to the excellence of motion pictures. Of special interest to SMPTE members are the Scientific and Technical Achievement Awards. Last year, awards in this category were presented to eight individuals, of whom seven are SMPTE members. The coming presentation ceremonies are expected to be enhanced by the elimination of commercials, as the Awards are now sponsored by the industry as a whole rather than by various commercial organizations, as has been the custom in the past.

As predicted in the *Journal* (Oct. 1957 p. 636), bills have been introduced in both Houses of Congress outlawing all forms of pay-TV. Until the question of jurisdiction is settled and/or Congress approves or disapproves the proposed legislation, the merits of the respective systems will be of only academic interest. It is entirely possible that the legality of the Federal Communication Commission tests of toll-TV will be tested in the Courts. If a suit were brought against the FCC as a result of its issuing a license for toll-TV, it would be up to the Court to decide if the agency had the power to issue such a license.

It is unlikely, for a number of reasons, that proposed legislation banning pay-TV will be brought to the House Floor during this session. Meanwhile FCC Chairman John Doerfer has emphasized that as things now stand, the FCC can cancel any test license if it finds pay-TV to be against public interest. "I am perfectly willing to handle this hot potato," he said during hearings before the House Commerce Committee. Only one toll-TV application has been made, to date, following the FCC statement authorizing applications for pay-TV permits on a limited test basis.

The Kodak Building at the Brussels Universal and International Exhibition of 1958, a 100 by 40-ft glass pavilion, will serve as photographic headquarters for the exhibition. Information and advice on all types of photography will be available to the anticipated 35 million visitors. The Exhibition opens April 17 and extends through October 19. The pavilion,

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designed by London architect Jack Howe, will be located near the Esplanade Gate to the 500-acre fairgrounds in Hysel Park, four miles from the center of Brussels. Buildings of other American firms will be located nearby.

Educational television received attention from Averill Harriman, Governor of New York, in his 1958 message to the State Legislature: "Our experimental programs in closed-circuit televison have proved that such techniques can be extremely valuable both in teacher training and in extending the reach of good teachers to more pupils than would otherwise be possible. These programs should be extended. Facilities for UHF telecasting are now available inexpensively in the capital district and I am hopeful that we can work out a feasible program for New York State's first educational television station. Several nonprofit private organizations are doing splendid work in this field. Last year, your honorable bodies approved funds for a program of state aid to communities for educational television, but failed to pass the necessary enabling legislation. I trust enabling legislation will be enacted this year."

Earlier in his message, the Governor stressed the need for education in science and engineering: "The most immediate need. . .is to provide more and better instruction in science, mathematics and engineering at all levels. . . ."

Educational television is broadly covered by a collection of reprints of significant articles assembled in a folder which has been issued by *RCA Educational TV News*. Reprints of recent articles include "The Schools of Tomorrow" from *Saturday Review* and "Television as a Teaching Medium" from *College and University Business*. An especially interesting article in the folder is "TV and the Crisis in Education" from the October 1956 issue of *Broadcast News*. *RCA Educational TV News* is issued monthly and contains brief items of interest in the educational TV field. The folder is available without charge from Dept. ETV-1157, Radio Corp. of America, Bldg. 15-1, Camden 2, N.J.

A total of 734 research programs were conducted by Armour Research Foundation of Illinois Institute of Technology during the fiscal year ending August 1957. A 68-page annual report summarizes the studies carried on in 49 general categories. The Foundation, which has done considerable research in the field of magnetic recording, reports that 11 new magnetic recorder manufacturers were licensed during the fiscal year to use any of the more than 250 patents owned by the Foundation. A total of 71 companies participate in the Foundation's magnetic recording program. Eight new magnetic recording patents were added during the year and six new patent applications were filed. Seven magnetic recording research projects were carried on in such areas as high-frequency recording, gas discharge playback heads and long-wave magnetic recording.

The Foundation has 1,290 staff members and occupies buildings covering 345,000 sq ft. It has been in existence 21 years.

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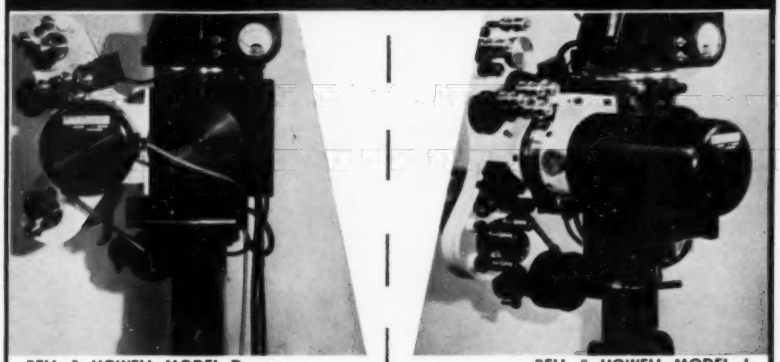

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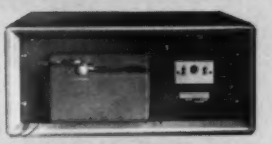

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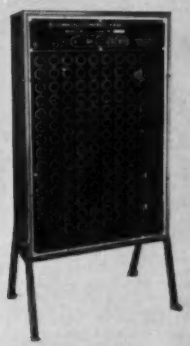

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The preservation of sound recordings, a field in which little, if any, basic research has been done, will be studied by the Library of Congress in cooperation with the Southwest Research Institute of San Antonio, Tex. The Institute will conduct the major work of experimentation and a group of scientists, headed by Dr. William Prager of Brown University will act as consultants. The project is financed by a $65,000 Rockefeller grant. The investigation, limited to shellac, vinylite and acetate discs, and magnetic tapes, will be aimed at determining the life expectancy of various kinds of recordings and finding suitable methods of preserving them. The investigation is expected to be concluded during 1959 and a report will be published.

A mammoth land-development plan involving a $400 million investment has been announced by 20th Century-Fox. The development, which will be named Century City, will cover 176 acres of the studio's 284-acre production lot and will accommodate a population of 15,000 in luxury apartment buildings, with facilities for 20,000 workers in the area. Three 20-story office buildings, a 1000-room hotel, a shopping center and a film industry center with a special office building, 500-seat theater, motion-picture museum, exhibit hall and an auditorium seating 4000 persons are included in the plans. The multi-million-dollar real estate deal will in no way impinge upon or curtail the company's motion-picture production activities, according to statements issued by company officials.

Norwood L. Simmons has been named Assistant Manager of the West Coast Div. of the Motion Picture Film Dept. of Eastman Kodak Co. Mr. Simmons joined Kodak in Rochester, N.Y., in 1937 as a member of the department of manufacturing experiments at the Kodak Park Works. In 1939, he joined the development division of the roll coating department and a year later became assistant supervisor of the division. He transferred to the West Coast in 1941.

Vaughn C. Shaner has been appointed to the post of Chief Engineer of the West Coast Div. of the Motion Picture Film Dept. of Eastman Kodak Co. He joined Kodak Research Laboratories in Rochester, N.Y., in 1935. In 1937, he transferred to the West Coast where he has served as chemist and color consultant for the Motion Picture Film Dept.

Robert W. Eberenz has joined the recently expanded Sound Department of Byron Inc. film laboratory, 1226 Wisconsin Ave., N.W., Washington, D.C. Prior to his present appointment he was sound transmission engineer and chief engineer of Fine Sound Inc. and Perspecta Sound Inc., a Loew's Inc. subsidiary. He has also served as field engineer for Altec Service Co. and during the Korean War he constructed and operated a USIS motion-picture unit which produced films used in the rehabilitation of communist prisoners of war.

Boyce Nemec has been appointed Executive Vice President of Reevesound Co., 35-54 36th St., Long Island City 6, N.Y. Executive Secretary of the Society from 1946 to 1956, for the past two years he has been an independent management consultant specializing in administrative and technical aspects of motion pictures and television. During World War II he was a director of the Army Signal Corps photo and motion-picture research and development laboratory. Prior to his service with the Army he was on the staff of the Visual Education Department of the University of Minnesota.

Roger Wade Productions, Inc., 15 W. 46 St., New York, has announced two new appointments. Howard A. Mann has been appointed Chief Film Editor and Thomas B. Williams has been placed in charge of sound slidefilm production. Mr. Williams came to the company from Transfilm Inc., where he served as production manager of its sound slidefilm department and as account executive. Mr. Mann will serve as chief editor of all the Wade organization's motion pictures and TV commercials. He was formerly with Hartley productions, Robert Yarnall Richie Productions and Transfilm.

A. A. Ward, Executive Vice-President, and Director of Altec Companies, Inc., has been elected President. He joined the newly formed Altec Service Co. in 1937 as head of specialty engineering and

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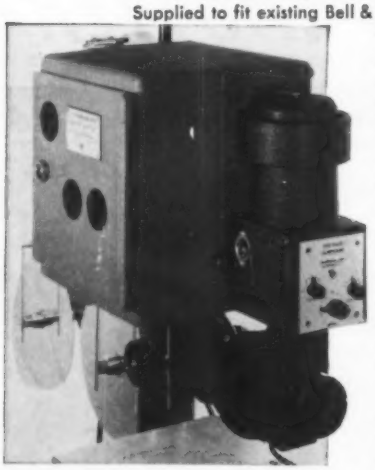

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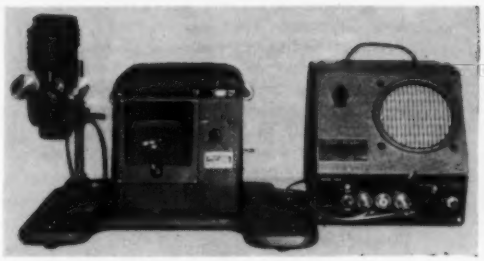

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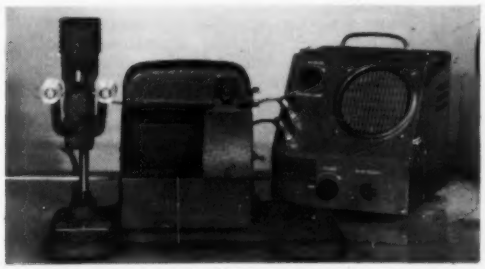

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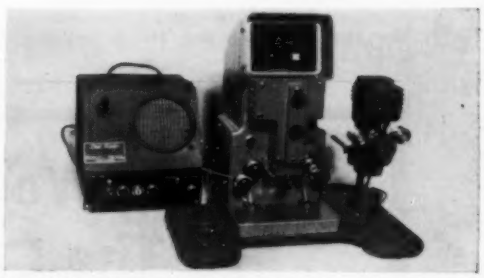

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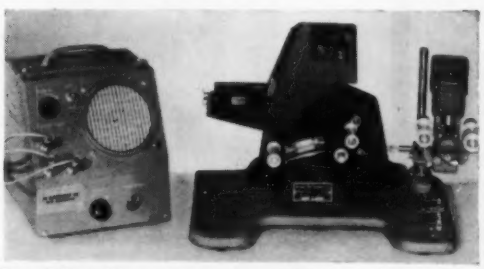

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was appointed General Manager of Altec Lansing Corp. following its formation in 1941 and later became its Vice-President and Director. He was elected Vice-President and Director of Altec Companies, Inc., following its organization in 1956. A member of the Society, he is known as a specialist in acoustics and sound engineering. He will maintain offices at Altec Lansing Corp. headquarters at Anaheim, Calif.

John K. Hilliard, Director of Advanced Engineering, Altec Lansing Corp., Anaheim, Calif., has been elected Staff Vice-President. In his new post, he will direct research and development in electro-acoustic and high-intensity sound fields. His recent work has included the development of environmental high-intensity sound chambers for pretesting aeronautical and missile components. A Fellow of the Society, Mr. Hilliard is the author of numerous papers on sound recording and reproducing, many of which have been published in the *Journal*, and he has been active in Society committee work. He is a member of the U.S. Research Council's Committee on Hearing and Bio-acoustics.

A. M. Zorem, President of Electro-Optical Systems Inc., Pasadena, Calif., will be principal speaker at the dinner meeting on April 23, during the 1958 Electronic Components Conference at the Ambassador Hotel, Los Angeles. He is widely known for his work in the fields of electronics and mathematics. Theme of the Conference is "Reliable Application of Component Parts." E. E. Brewer is Technical Program Chairman. Further information is available from Publicity Chairman, David M. Knox, Packard-Bell Electronics Corp., 12333 W. Olympic Blvd., Los Angeles 64.

Walter C. Granville, Chicago color consultant, has been elected President of the Inter-Society Color Council which represents 27 national organizations in the fields of color in science, industry and art. An independent color consultant, Mr. Granville has a nation-wide reputation for his work in color standardization and architectural color planning. Other newly elected officers are: Vice-President, G. F. Erikson; Secretary, Ralph M. Evans; Treasurer, Norman Macbeth.

Lee E. Jones has been elected Executive Vice-President of the Neumade Products Corp., 250 W. 57 St., New York 19. He joined the firm in 1938 and since 1943 has been Sales Manager. The firm has been active in the 16mm field and has widened its interests to include electronic data processing equipment and automation products. A member of the Society, Mr. Jones has long taken an active interest in SMPTE affairs.

Mrs. Oscar F. Neu was elected President of the company to succeed her late husband, Oscar F. Neu.

Myron Baldwin has been appointed sales manager of the Instrument Div. of Beckman & Whitley Inc., San Carlos, Calif. In his new post he will direct the marketing of high-speed research cameras and meteorological instrumentation systems. He has been associated with the firm since 1952 and prior to his present appointment was product manager of the Camera Dept. A member of the Society, he is also a member of the Society of Photographic Instrumentation Engineers and the Society of Industrial Photographers.

section reports

To close out the very full year of 1957, the Chicago Section was honored to have J. M. Maurer of JM Developments, Inc., as its speaker for the December 10 meeting. Mr. Maurer, assisted by Russell Holslag, presented two papers entitled "The 16mm Film Laboratory" and "Improvements in Variable-Density Sound Recording" and also demonstrated the quality of the new variable-density system of recording.

Through the fine efforts of George Colburn, long-standing supporter of the Chicago Section, the meeting was held on the sound stage of Colburn Film Services Studio in Wilmette, Ill. Preceding the meeting, the officers and managers of the Section joined twenty-five members for dinner at Marshall Field's Crabapple Room in the new Old Orchard Shopping Center in Skokie.

As a tribute to the excellent program and speaker, 138 people attended the meeting despite a sleet storm with associated icy streets.

The outgoing Chicago Section Chairman would like to take this opportunity of publicly thanking all the fine officers, chairmen and members, who assisted so faithfully and well with the functions of the Chicago Section during the past two years. Whatever measure of success was achieved by the programs and activities in the Chicago Section during this period was due in large part to this fine cooperation. The assistance of the SMPTE New York office, Executive Secretary, and Officers and Governors was also greatly appreciated.—*Ken Mason*, Chairman 1956–1957, c/o Eastman Kodak Co., 130 E. Randolph Dr., Chicago 1.

The Dallas-Ft. Worth Section's January meeting, held on the 10th, took the form of a guided tour through Amon Carter Field, the Ft. Worth Air Terminal. After dinner, the CAA, the Weather Bureau and American Airlines conducted tours of their facilities for the 35 members of the section who were present. Of particular interest to the members was the radar and electronic equipment used by the CAA and the Weather Bureau. Plans for future meetings were also discussed by the gathering.—*E. J. Pattist*, Secretary-Treasurer, 3618 Marsh Lane Pl., Dallas, Texas.

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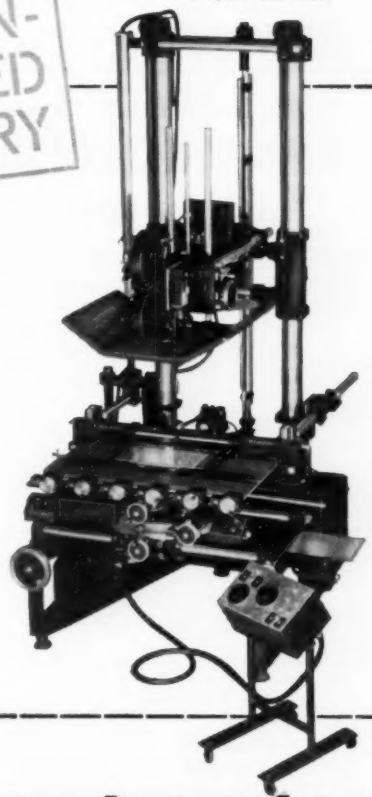

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The San Francisco Section meeting for January was held on the 14th at the Dinkelspiel Auditorium, Stanford University. More than 150 were in attendance, both from the Society and the IRE Professional Group on Audio, to hear Dr. John G. Frayne, Engineering Manager, Westrex Corp., describe the Westrex Stereophonic Disc System. A monogroove system is utilized, with each of the two channels cut at an angle of 45° from the vertical by a single stylus. Cross-talk between the two channels is held to −23 db at frequencies below 8 kc. Quality of each channel is identical to that obtained by present disc recording techniques and the system is compatible. A standard recording played on the stereo system results in both speakers reproducing the same signal.

Following Dr. Frayne's talk, he was assisted by C. C. Davis and Rex Jordan, both of the Westrex organization, in presenting a very effective demonstration and in answering questions from the floor. A stereo cutter was on hand for examination by the group following the demonstration.

The meeting was preceded by cocktails and dinner at Hal's Restaurant in Palo Alto.—*Roger L. Woodruff*, Secretary-Treasurer, KRON-TV, 929 Mission St., San Francisco.

The Rochester Section heard a very interesting and informative talk by Paul Cherney, President of Cinefot International Corp., on "Exploring the Secrets of the Underwater World" at its January 16 meeting in the Kodak Office Auditorium. A gathering of 81 was on hand to listen to Mr. Cherney describe the problems of underwater photography as regards the motivation of the photographer and his specialized equipment. Mr. Cherney illustrated his talk with a film showing some of the results he and his associates had obtained in their work.—*Richard E. Putman*, Secretary-Treasurer, 420 E. Corey Rd., Rochester, N.Y.

The Atlanta Section met at Beeland-Wood Films on January 20 with an attendance of 38 plus the rain which always seems to be present at the meetings of this Section.

Robert M. Corbin, Eastman Kodak Co., discussed the development of motion-picture film in nontechnical terms. One of the points mentioned was that the base for early film was poured on glass and that the largest length available was 200 ft. Mr. Corbin also brought out the fact that Eastman Kodak finds it difficult to discontinue an emulsion, because there is always someone using it in a way the film was never originally intended to be used and new and improved replacements will not work for some users.

Following Mr. Corbin's talk there was an informal discussion to plan the meetings for the coming year.—*Edward E. Burris*, Secretary-Treasurer, c/o Beeland-Wood Films, Inc., 752 Spring St. N.W., Atlanta, Ga.

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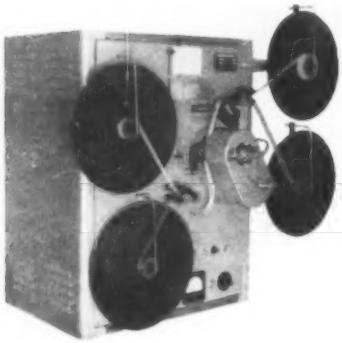

This printer makes contact prints from 16mm negatives onto 16mm positive, or from 16mm reversal onto 16mm reversal printing films. It is sprocket driven and will operate at a rate of 40 feet per minute.

Among its many features, it has a semi-automatic mechanical light change mechanism, a light card indicator, a 40-tooth printing sprocket, a constant speed gear reduction motor, and an electrically operated footage counter. A high current low voltage lamp is used as the light source.

The frame of the printer is housed in a steel cabinet. This cabinet features doors both in the top and in back to give full access to the rear of the printer for ease of maintenance.

Any one of four apertures can be selected: sound, negative to positive picture area only, reversal to reversal picture area only, or full aperture.

Weighted rollers precede the printing sprocket on both negative and positive films. This and a pressure roller over the printing aperture ensure excellent contact between the films during printing.

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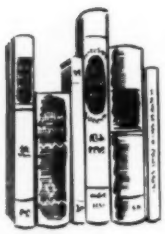

books reviewed

Underwater Photography Enlarged 2d ed.

By Hulbert Schenck, Jr., and Henry Kendall. Published in 1957 (1st ed. 1945) by Cornell Maritime Press, Cambridge, Md. 160 pp. incl. plates and illus. 5½ by 8¼-in. Price $3.50.

Just as the authors of this excellent little book had to draw on many people for advice and aid so the reviewer, who is conversant only with surface photography, had to ask for help from men experienced in underwater photography.

We are all in agreement that this is a good basic textbook on a fascinating and difficult subject. With the two companion books by these authors one would be quite well able to live under water. In this volume not one of the many facets important to the production of good underwater photographs is left out. The necessary fundamental optics as they apply to underwater photography may scare the wits out of a beginner but they are described with a minimum of formulas and a wealth of succinctly written details. In the chapter, "Materials of Underwater Photography," various types of cameras, lights, flash, strobe and continuous are discussed, as well as films. As it should be, the largest chapter in the book deals with underwater enclosures for cameras and flash equipment. The reader is not only made aware of the commercially available enclosures but also is told how to build such units himself. Nowhere are we left very much in doubt as to how the authors feel about the merits of certain pieces of equipment. The authors are to be commended on their courage to mention a brand name and to tell us exactly how they feel about its cost and its quality.

Reflection and refraction, which affect the quality and quantity of underwater light, are explained in detail in the chapter "Underwater Exposure by Natural Light." A most important portion of this chapter is that dealing with color correction and how to determine the amount necessary and what filters to use.

The Chapter, "Artificial Light," is divided in two parts, one for black-and-white photography, the other for color. Small mention is made of photography in turbid water. The short, last chapter advises one to acquaint himself with his photographic and diving equipment in a swimming pool before setting out into the depths. This is a point well worth remembering. There is a short description of processing films while at sea and a much too short bit on underwater motion pictures. Since fish do not necessarily stay around within shooting distance for long scenes the author cleverly advises shooting at a high frame rate in order to stretch out the scene during projection. For those who are interested, a lengthy bibliography is included in the Appendix.

In criticism it may be said the style is dry and the writing not conducive to stimulating great interest. Not enough stress is placed on the most important cautions for the real amateur or beginning professional. One needs to go through the whole book to pick them up here and there. There should be a summary of techniques for the amateurs. No mention is made anywhere of the use of side lighting. It is felt that much more use should be made of this type of lighting especially in turbid water. It is necessary to go after invertebrates but why not let the fish come to you? Good background may be selected and properly lighted for artistic shots.

The following are a few random and disconnected observations. It transpires from the text but it never definitely mentioned that many of the commercial cases have plastic fronts. These are easily scratched. All plastic cases should be limited to 12 sq. in. Anything larger bends. Not mentioned is the use of an automobile tire valve to check for leaks before diving. Air pressure may be built up inside the enclosure and any leakage can be seen by dunking in a bath tub. In large cases the camera can be mounted on a shelf which makes it possible to slip the camera in and out more easily than by having to disengage it from the case. Super Anscochrome film has been marketed since publication of this book. This film gives excellent underwater pictures without filtration. It may be mentioned that it is hard to change speeds on the Leica. The reviewer feels that not enough importance has been placed on the background. Holding a white card to tell what filter is needed is pretty much like the barometers which tell you it is raining when the animal's tail is wet, or windy when it is moving about! It is often found tonal values of black-and-white prints are better when made from Kodachrome originals than from original black-and-white negatives—*Fred Anderegg*, Photographic Services, University of Michigan, Ann Arbor, Mich.

Howard W. Sams & Co., 2201 E. 46 St., Indianapolis 5, Ind., has announced publication of two books, *Tape Recorder Manual*, Vol. I (first of a new series) and *Automatic Record Changer Manual*, Vol. 10. The first book covers seven basic tape recorder chassis and two tape players produced in 1956 and 1957. Tape recorders for home and professional use are described. Illustrations include photographs of recorder and amplifier and amplifier schematics. The second book covers 10 record changers produced during 1956 and 1957. General specifications and operations data are described. Assembly and parts list information is given in photographs and exploded views. Each book is 8½ by 11-in., contains 148 pp. and is priced at $2.95. The books are distributed through electronic parts distributors throughout the country.

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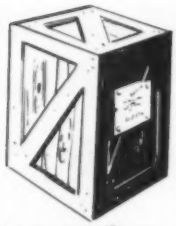
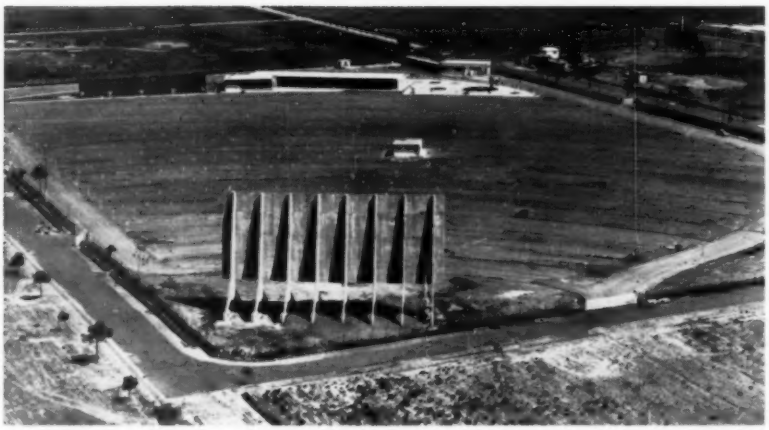


new products

(and developments)

Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.



The first bilingual drive-in theater in the world (and the first drive-in in Europe) opened in Rome last winter. Owned by Loew's Metro, the drive-in has a capacity of 800 cars and covers an area of about 66,000 sq yd. The parking area is divided into 17 ramps. The screen tower is 68 ft high and 125 ft wide and is constructed of reinforced concrete. The screen is tilted 5° and curved on a 755 ft radius. The projector booth is placed on the ninth ramp at a distance of about 450 ft from the screen. An aerial view is shown above.

Most of the sound equipment was installed by Westrex Co., Italy, which designed and assembled the bilingual equipment. In the bilingual operation, the Italian language sound version is the standard photographic track of the release print and the original language version is a magnetic re-recorded soundtrack on a separate 35mm film.

To reproduce simultaneously the two soundtracks for bilingual transmission, a Westrex R6A photographic reproducer is mechanically interlocked with an R8B magnetic sound reproducer for standard single track reproduction. The viewer can change from one language to another by a turn of a switch on an in-car speaker.

Chroma-Key, an electronic color "process photography" system, is described in the January 1958 issue of *Electronic Age*, published by Radio Corp. of America. Now in use by the National Broadcasting Co. for live television production, the actors perform on a bare stage and the backgrounds are added electronically. The process is based upon patents taken out between 1929 and 1939 by A. N. Goldsmith, a Fellow and a Past-President (1932–34) of this Society.

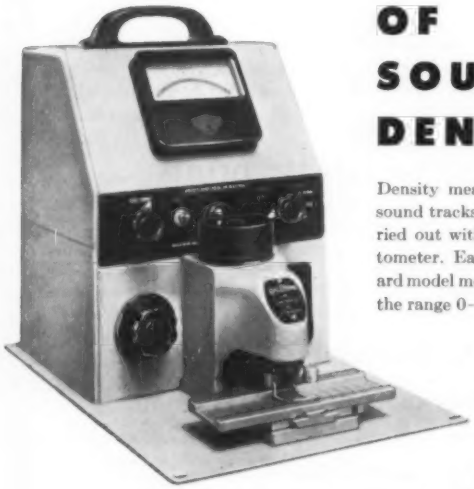
The floor and screen used as a backdrop for the actors are painted blue. The action in front of the screen is picked up by a regular TV camera, the signal going to a special effects amplifier which simultaneously receives the background picture signal from a second camera. A switching signal, or color key, controls the signal composed for transmission. While the live-action camera is scanning the blue of the background screen the other, or background, signal is automatically switched in; when the scanning signal reaches the live actors, the background signal is switched out. Actors cannot wear blue, on penalty of having background switched through that part of them. A third signal can be employed to put a middleground between the foreground and background.

When the live action is inserted within miniature sets, the perspective is controlled by the use of a long-focus lens to magnify the model to correspond with the size of the actors, or a short-focal length lens to reduce the actors to the size of the sets.

The process was brought to its present stage of development by RCA engineers working with the early patents granted Dr. Goldsmith. In this connection, it is interesting to refer to Dr. Goldsmith's ideas as expressed in articles published in the *Journal*, particularly "Theater Television — a General Analysis" in February 1948, pp. 95–121.

At the forthcoming Convention in Hollywood the system and equipment will be described by Frank J. Gaskins of NBC's Color City at Burbank, Calif., where the system has been used increasingly over the past year.

ACCURATE MEASUREMENT OF SOUND TRACK DENSITY



Density measurement of negative and positive sound tracks can be speedily and accurately carried out with the Baldwin Sound Track Densitometer. Easily fitted to a rewind desk, the standard model measures black and white density over the range 0—4.0 using an aperture 0.10″ long by 0.02″ wide, and colour density over the same range using an aperture 0.10″ long by 0.045″ wide. All models are supplied with the scanning slit parallel to the film perforation.

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Whatever your magnetic recording medium—35mm film, ¼" audio tape, or 2" video tape—the new RCA Model 10891 Eraser is the answer to the problem of effectively removing recorded magnetic signals. Several of these feature-packed erasers have already been installed in the studios of major television networks.

See the new RCA Bulk Tape and Film Eraser demonstrated at RCA booth, SMPTE Exhibit, Los Angeles, April 21-25.

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A black-and-white film process for color television has been developed by Bryg, Inc., 324 S. McKean St., Butler, Pa. Based on the principle that in human vision there is less sensitiveness to color detail than to luminance (black-and-white) brightness details, the system uses a maximum frame size, in either 35mm or 16mm, for the black-and-white component. The other part of the double-frame contains two smaller images, in black-and-white, one filtered red, the other blue. Through electronic matrixing, the green signal is provided in the projected signal.

A technical presentation of the system is scheduled for the Spring Convention in Hollywood by Dr. Adolph Razdow, Vice-President for Engineering, Bryg, Inc.

Operational research and development equipment has been installed, and demonstrated, for some time at WJAC-TV, Channel 6, Johnstown, Pa.

Approximately 100 Ampex VR-1000 magnetic tape recorders are scheduled for delivery by Ampex Corp. before the beginning of Daylight Saving Time in April. Announced as "a major production achievement" by the company, it had previously stated that the backlog of orders could not be filled before November. Recorders have been reported en route to WFIL-TV, Philadelphia; WEAR-TV, Pensacola, Fla.; WOR-TV, New York; KENS, San Antonio, Tex.; WHAS-TV, Louisville, Ky.; and KHJ, Los Angeles. The units consist of a tape console and two racks of electronics with more than 190 tubes. Stations which recently received the recorders are: KING-TV, Seattle; KGW-TV, Portland, Ore.; KRON-TV San Francisco; KPRC-TV, Houston.

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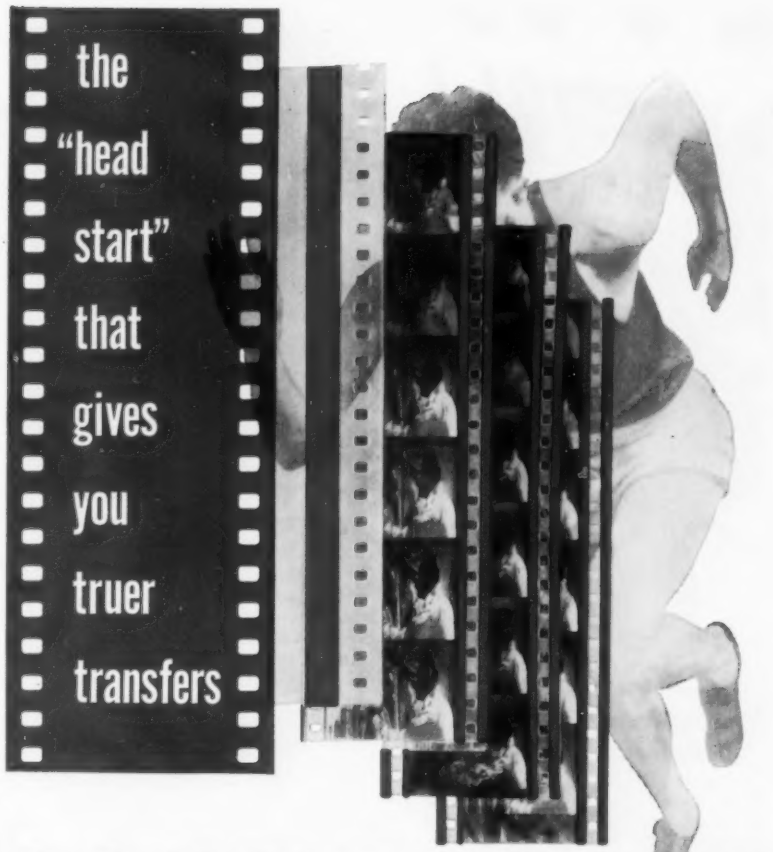
Triad Color Control, a 16mm reversal-additive printing process providing scene-to-scene color correction and control, has been introduced by Southwest Film Laboratories, 3024 Fort Worth Ave., Dallas 11, Tex. Described in a paper presented at the January meeting of the Dallas-Fort Worth Section by Southwest's Vice-President Jack Hopper, the process is designed for the highest possible color control, especially effective for scene-to-scene color balancing. Colors can be subdued or brightened as well as reproduced with exactitude. The entire operation is controlled electronically by punched tape, for effective production of numbers of prints.

A $2 million dollar color film processing laboratory has been completed by Movielab Color Corp., 619 W. 54 St., New York 19. The plant has been designed to provide a complete range of service in both 16mm and 35mm color, the firm having for some time supplied a large capacity for black-and-white service as one of the country's most important independent film laboratories. Available at the expanded plant are the Movielab Color negative, color intermediate and positive processing, color-balanced additive scene-to-scene Kodachrome printing and "blow-ups" from Kodachrome to 35mm Eastman color negative.

At an Open House on February 11 guests were given a chart indicating ten different color duplicating methods and were given guided tours through the plant including the printing room which features an "electronic brain" for controlling scene-by-scene color balance for both 35mm and 16mm. Much of Movielab's equipment has been designed by the firm's own staff, for example, the Movielab Octette printer which makes eight reduction prints simultaneously with one pass of the 35mm negative through a single aperture.

The new laboratory was designed by the company's staff on which James W. Kaylor is Chief Engineer, and Nicholas Gensinger is Mechanical Superintendent. Saul Jeffee, President, has reported an increased volume of business during the past year and an increase in staff by 40%, with TV commercials, international TV program films and industrial motion pictures supplying an important volume.

Installation of a new Westrex high-fidelity sound recording system reported to be first of its kind in the 16mm film industry in the United States, has been announced by Byron Inc., 1226 Wisconsin Ave., N.W., Washington 7, D.C. The system includes two mixer studios, two narrator studios and a theater recording studio with 16mm and 35mm projection facilities. Recording facilities include two 35mm and two 16mm optical dubbers, two 35mm and four 16mm magnetic dubbers, three 16mm and one 35mm magnetic recorders, 16mm film recorder, ¼-in. tape with Rangertone sync. The 8-input re-recording console has sliding faders, graphic equalizers, effects filters, low and high position filters. The entire system is interlocked for forward or reverse. Other features include looping facilities, high-fidelity monitoring systems and special double-speed transfer system.



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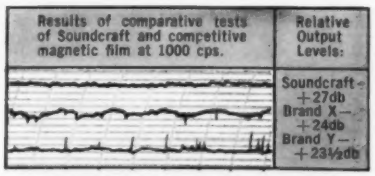
Results of comparative tests of Soundcraft and competitive magnetic film at 1000 cps.
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There is no substitute for the Miracle Presto-Splicer. It has no equal—it is the world's only professional butt-weld splicer which fuses the film back to its original condition...end to end.

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PRESTO-SPLICER MT-1M perfectly aligns and permanently welds ¼" tapes without cements or adhesives. Precision diagonal splice is actually a plastic fusion, capable of withstanding three pound pull. Thumps and fallout completely eliminated. All splices identical—all trimming eliminated. Acclaimed best for professional editing.

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STillwell 4-6832

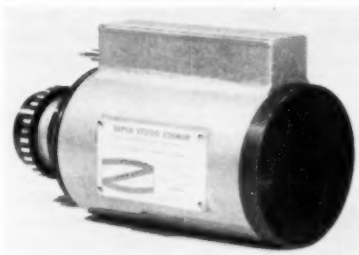
The Sellevision unit for a system of filmed programming has been brought out by Hallamore Electronics Co., a division of Siegler Corp., 6600 Sunset Blvd., Hollywood. The unit consists of a console which continuously projects slides or motion pictures on an eye-level screen in the upper part of the unit. The pictures, in color or black-and-white, are transmitted from a self-contained projector to the screen by means of three high-reflection mirrors. The system is designed for use in airline terminals, industrial plants, hotels and other commercial establishments. It is priced at $1475 for the slidefilm model and $1650 for the motion-picture model.

The OMD 135 magnetic reproducer has been announced by Reeves Equipment Corp., 10 E. 52 St., New York 22. A product of Magna-Tech, the reproducer employs a double flywheel system with a mu-metal shield covering head and sound drums. Controls are on one panel, including a microswitch which shuts off the motor when the rewind is completed. Maximum film capacity is 5000 ft of 35mm film. Rewind time is reported to be less than one minute for a 2000-ft reel. Internal connections are made through goldplated AN connectors. Modifications and additions, such as optical units or interlock motors, can be added.

A flutter meter designed for visual indication of flutter and wow content of all types of film tape and disk recording and playback equipment has been announced by Amplifier Corp. of America, 398 Broadway, New York 13. Built to IRE standards, the meter features a built-in 3000-c oscillator for recording purposes. A three-range filter is included to study and isolate flutter and wow components. The ranges are 0.5- to 6-c for wow; 5- to 250-c for flutter; and combined flutter and wow of 0.5 to 250-c. A frequency discriminator is used to demodulate the flutter signals which are then read on a calibrated meter as an rms value of sine-wave flutter components. A built-in limiting amplifier is designed to prevent erroneous readings from amplitude modulation components.

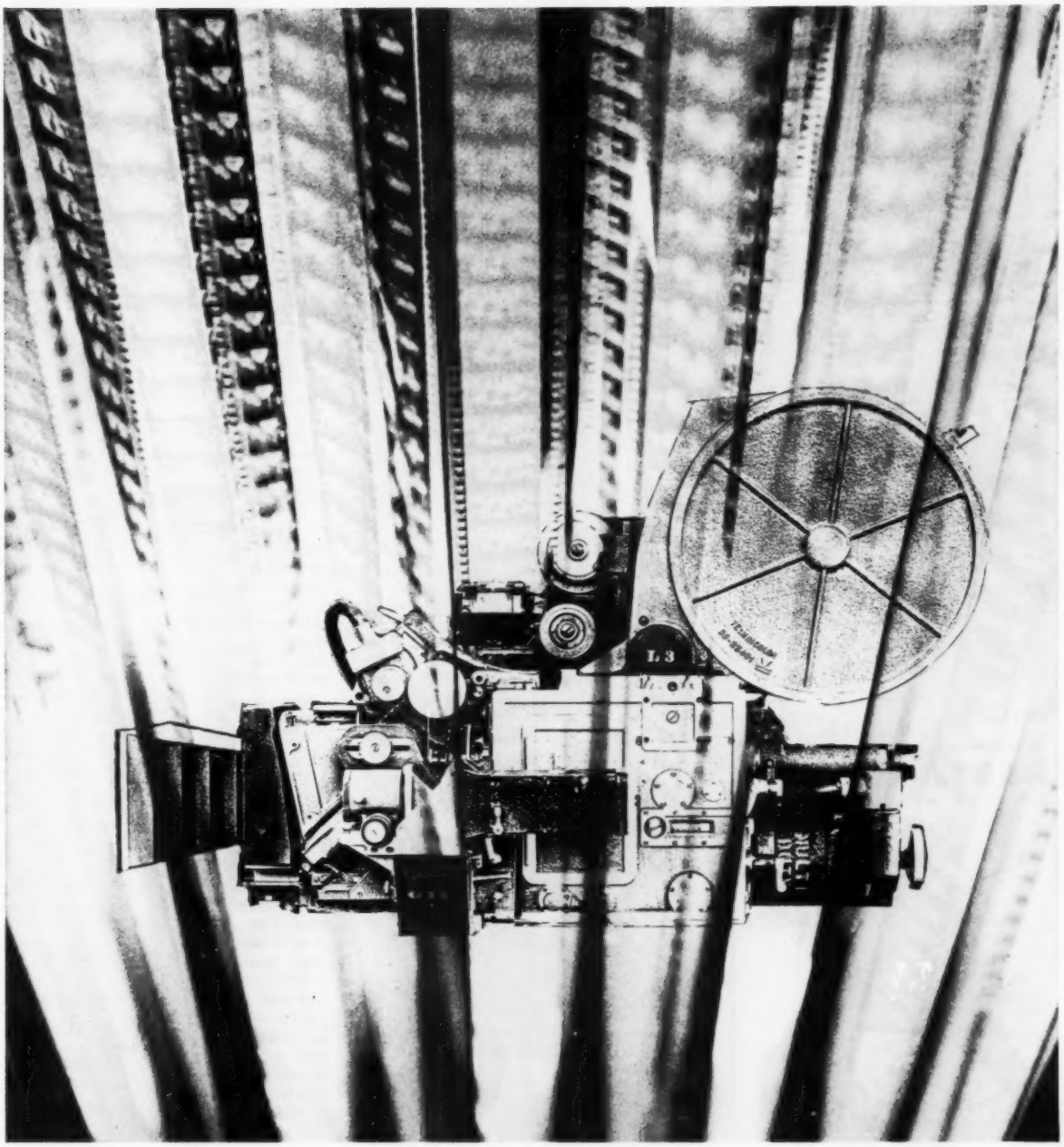
The built-in preamplifier and input attenuator will accept voltages ranging from 1 mv to 100 v. Connection may be made directly across magnetic tape playback heads, or across high-level circuits delivering up to 100 v. Assembled on a standard rack panel, dimensions are 8¾ in. high, 19 in. wide and 8 in. deep, with a net weight of 18 lb.

Educational Television Products Division of National Theatre Supply Co. has been appointed national distributor of General Precision Laboratory closed-circuit TV systems for educational institutions. Both companies are subsidiaries of General Precision Equipment Corp.



The Super Studio Zoomar lens, introduced by Television Zoomar Corp., 500 Fifth Ave., New York 36, is a further development of the company's Studio Zoomar. The new, 6-lb lens has a range of 55 to 180mm with a 3½ to 1 ratio, color balance and correction laterally and longitudinally and speed increased to *f*/2.7. It has been designed for ease of interchanging between cameras.

The Bell & Howell-Angenieux Zoom Lens for 16mm cameras has a maximum lens opening of *f*/2.2 and a 4-to-1 range of focal-length variation. Designed for amateur use, the focal length is adjustable from 17mm to 68mm and is equipped with a reflex viewfinder. Priced at $429.95, it fits all Bell & Howell 16mm cameras, except electric-eye models, and is standard equipment on the 240-Z camera. This camera features automatic threading and is priced at $579.95. Further information is available from Bell & Howell Co., 7100 McCormick Rd., Chicago 45.



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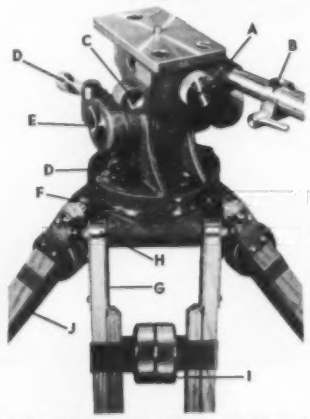

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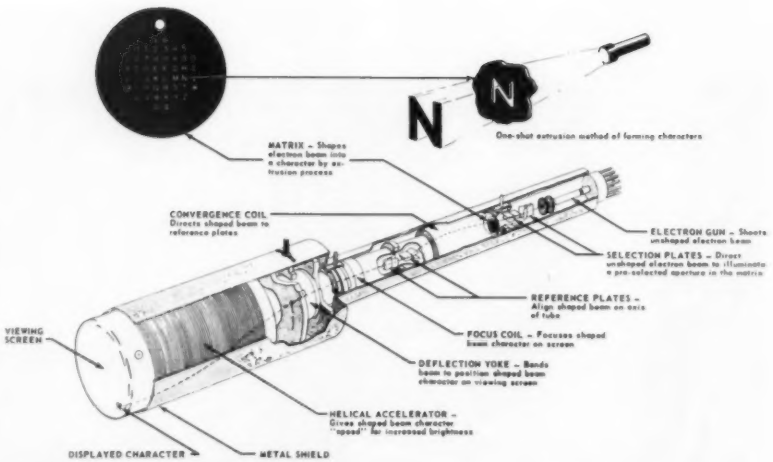
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One-shot extrusion method of forming characters
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REFERENCE PLATES – Align shaped beam on axis of tube
FOCUS COIL – Focuses shaped beam character on screen
VIEWING SCREEN
DEFLECTION YOKE – Bends beam to position shaped beam character on viewing screen
HELICAL ACCELERATOR – Gives shaped beam character "speed" for increased brightness
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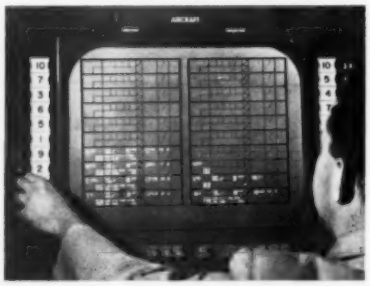
METAL SHIELD



The Charactron shaped-beam tube, Type C19Q, is a product of Stromberg-Carlson Division of General Dynamics Corp., Rochester 3, N.Y. The tube, which is similar to a TV tube, contains an electron gun which shoots its beams through minute openings which form the beam into characters as shown in the diagram. A 7-in. tube can display approximately one million characters a minute. The shaped-beam tube has been used in print-out equipment and, among other applications, can be used in air traffic control.

In the traffic control system, information on the various incoming and outgoing flights is displayed by letters, numbers and symbols on the face of the tube (see photograph). The information, which can be shown at the rate of approximately 50,000 characters a second, will be placed on the flight strip through means of a keyboard used by the controller. Other C19Q tubes may be used as situation displays, combining radar "blips" with superimposed letters, numbers and symbols to facilitate the identification of planes.

Among new equipment announced by Camera Equipment Co., 315 W. 43 St., New York 36, are a Balanced Pan and Tilt Head for Vidicon TV Cameras and a 110-v a-c Synchronous Stop-Motion Motor for the Maurer Camera. The pan and tilt head is spring balanced and features a built-in spirit level, telescoping pan handle and tension adjustment. The motor for the Maurer Camera features d-c braking, forward and reverse switches, continuous operation switches and a hand control switch for single-frame operation.

A 28-lb viewfinder TV camera chain for classroom or studio use has been introduced by General Precision Laboratory Inc., Pleasantville, N.Y. Called GPL Model PD-250, the system consists of a vidicon camera with a 5-in. electronic viewfinder, 4-lens turret and portable or rack-mounted control unit. Equipment for studio installation is also available. Designed for one-man operation, the system incorporates printed camera wiring and silicon diode rectifiers in the electronically regulated power supply. The camera control unit supplies all control voltages, deflection signals, focusing current, intercom and operating power through a single cable which also feeds the video signal from the camera to the control unit for further amplification and distribution. The unit is available in portable housing or for mounting in standard 19-in. relay rack.

The second industrial TV training program for distributors of closed-circuit equipment manufactured by Allen B. Du Mont Laboratories, Inc., was held at the Boom Electric Co., 5226 West Grand Ave., Chicago, February 17–20. More than 50 representatives of distributors who have joined the Du Mont chain since August attended the sessions. Thirty-five franchised distributors, covering 119 metropolitan areas in the United States, have been appointed for Du Mont industrial TV equipment.

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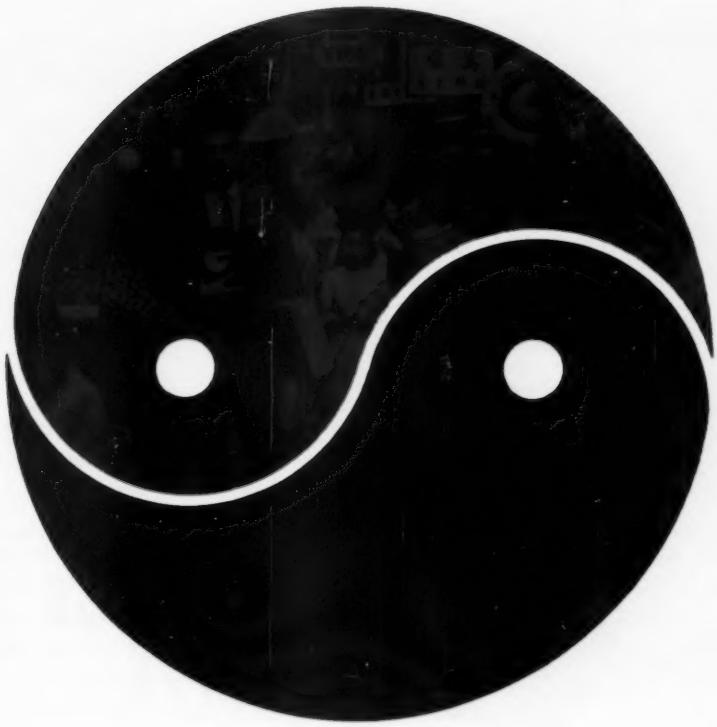

GENERAL FILM LABORATORIES CORP.

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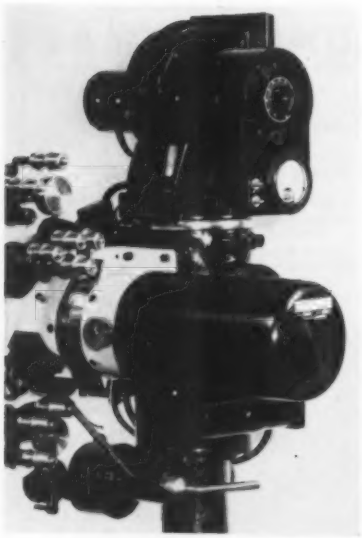
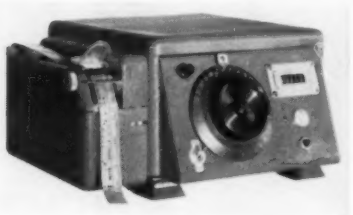


An automatic shutter for motion-picture printers has been announced by Electronic Systems of Illinois, Inc., 5433 W. Diversey Ave., Chicago 39. Manufactured for use with Bell & Howell printers, Models D and J, the shutter is also supplied with a modified mounting to adapt to the Peterson Printer. The shutter is fully automatic and provides a zero light in addition to the prescribed light intensities. Two types of control systems may be used with no modification of the shutter. One control system uses standard 1-in. paper tape coded to correspond with the Bell & Howell punch tape used on the color additive printer. The other system uses an automatic control panel which stores information for up to 150 scene changes in any one run. If more than 150 scene changes are required the operator may reset the first selector positions as the numerical indicator shows that they have been passed during the run. A full technical paper on the shutter is scheduled for presentation at the forthcoming Spring Convention by Theodore W. Batterman and Mathew Pobog of Electronic Systems.

A Tape Punch and a Tape Duplicator have been introduced by California Technical Industries, Division of Textron Inc., 1513 Old County Rd., Belmont, Calif. Designed to speed processing of data punched in standard, 1-in. tapes, the new products augment the CTI Tape Reader, a device that presents 80 bits of information at each advance of the tape by simultaneously reading 10 transverse rows of 8 holes each. Conventional $\frac{1}{10}$-in. hole spacing is employed so that any one of the three units can be adapted to existing equipment.

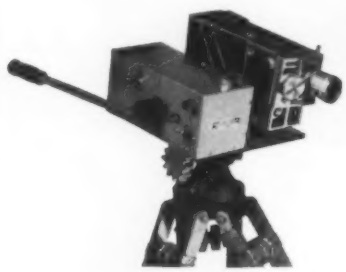
Electrically powered, the CTI Punch allows the operator to set up an 8-hole line on pushbuttons which illuminate when pressed. The line can be changed or corrected before the command to punch is given. The tape advances when punched, and a counter indicates the number of completed lines. The Duplicator automatically reproduces copies of tapes by coordinating the Punch with the Reader. The device, which punches over 900 lines a minute, is useful for making tapes for use at several stations and for editing and revising old tapes. Both units are $9\frac{3}{4}$ in. wide and 16 in. deep. The punch and Duplicator are 11 and $4\frac{1}{4}$ in. high, respectively.



The Dial-Matic Perforator, a self-contained unit using standard 8-hole 1-in. paper tape, is a product of Electronic Systems of Illinois, Inc., 5433 W. Diversey Ave., Chicago 39. Designed to be used with the Company's automatic shutter for motion-picture printers which uses standard binary codes, the unit can be adapted to perforate control tape for any system or control device where paper tape is used.

A portable echo chamber developed in Germany has been introduced by the Professional Dept., Hi-Fi Headquarters, 150 E. 46 St., New York 17. Called the EMT 140, its dimensions are 8 ft 2.4 in. by 1 ft 11.62 in. by 4 ft 3.17 in. It requires a 115-v power supply, has an input level of 1.55-v (program line), an output level of 1.55-v (program line) and a reverberation time between 1.2 and 6 sec. The echo chamber is described as offering a range of between 30 and 12,000 cycles. The chamber has been designed for installation so that several units can be operated next to one another without interference. It is described as made to sell under $2,000.

The NAVA Membership List and Trade Directory lists 400 audio-visual dealers. Information on types of services offered and available equipment is included. Dealers are listed by geographical locations. The Directory is available without charge to audio-visual users from the National Audio-Visual Assn., Box 337, Fairfax, Va.



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Special drive and control units available for Bell & Howell and Bolex 16 mm cameras. Inquiries for modifications and adaptations in this field are invited.

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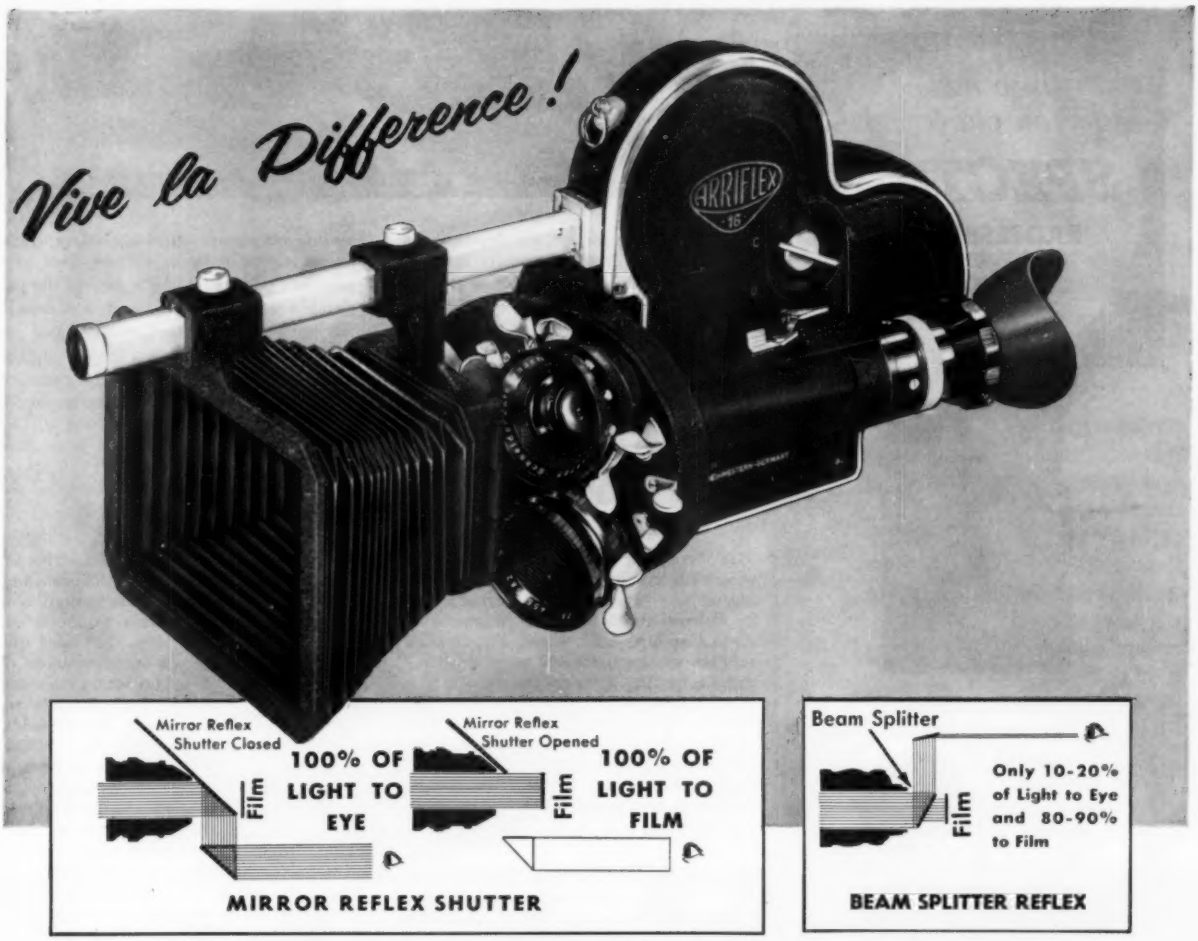

The great advantages of a reflex viewing system in a movie camera are obvious:

No parallax, no finders to match, no rackover inconvenience but continuous focusing and viewing through the taking lens.

There are two ways in which reflex viewing can be accomplished:

1. By means of a *mirror reflex shutter* which rotates at 45° between lens and film plane.

   The great advantage of this system is the fact that 100% of the light goes to the film and the eye intermittantly. When the shutter is open there is no interference between film and lens. When the shutter is closed, its mirror surface reflects all of the light to the eye. Result: Easy focusing and viewing on a bright crisp ground glass image even in dim light, or when the lens is stopped down.

   The Arriflex—designed for the professional—uses the mirror reflex shutter, which of course is a much more costly design.

2. By means of a *beam splitting mirror or prism* which is mounted between lens and film. This reflects some of the light (about 20%) to the eye and transmits the balance to the film.

   The disadvantages of this system are:

   The light reflected to the eye is so weak that it is difficult to focus or even sight, unless the lens is wide open and the scene brightly illuminated. In dim light, or if the lens is stopped down, the finder image is so weak it is practically useless. But the light going to the finder is taken away from the film, requiring the f stops of the taking lens to be specially adjusted. The beam splitter permanently in the light path, and close to the film plane, frequently accumulates dust and other foreign matter which may ruin the picture.

Don't take our word for it! Try it yourself. Take an Arriflex 16 and a "beam splitter reflex" and look at the same scene, through similar focal length lenses, at various f stops from wide open to f22. You will exclaim with us: Vive la difference!

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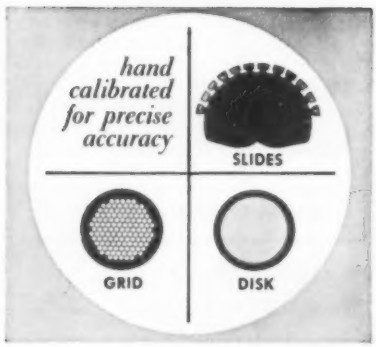

Popular for over a decade, the original model A has been greatly improved and is now available under the trade name "Spectra Professional".
It is especially designed for use in the motion picture, TV and professional photography where instant direct reading and great accuracy is a prime requirement. The ultra sensitive SPECTRA professional exposure meter comes complete with disk, grid, 12 film-speed slides and carrying case $97.50

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An ultrasonic recorder, developed to test fuel elements for atomic reactors, has been used to photograph the bones in a living human arm. The technique of bone photography without x-rays is the same as that used in detecting flaws in reactor fuel elements. The recorder was developed at Argonne National Laboratory, P.O. Box 299, Lemont, Ill.

In testing reactor fuels, a fuel element is suspended in a tank of water. An assembly consisting of two crystals, one to transmit and one to receive ultrasonic waves, traces across it repeatedly in narrow lines in a sawtooth pattern. When a flaw in the fuel element is "caught" between the crystals the waves are absorbed and the flaw appears as a white space on a sheet of electrosensitive paper attached to the recorder. In bone photography, the same method is used, with the recorder adjusted so that differences between flesh and bone show on the electrosensitive paper.

The Strobotac is a useful device for measuring the speed of rotating, reciprocating or other cyclic motion, manufactured by General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass. The machine supplies stroboscopic light which "freezes" rapidly moving parts or processes making possible detailed examination of the action while at full speed. The device has been used in laboratory testing to check on the uniformity of a sprocket drive (Robert O. Gale and John J. Graham, "Use of a motion-picture printer as a sensitometer," *Journal*, Feb., 1958, p. 86).

The George Scherr Co., 200 Lafayette St., New York 12, has announced a Lustro-Chrome Vernier Caliper made of stainless steel and faced with dull chromium throughout for ease in reading even in poor light. The Shop Vernier Caliper is for measuring outside, inside and depth dimensions up to $5\frac{5}{16}$ in. A double length vernier has been added and a raised edge design is used to protect the chromium surface. The caliper is graduated to $\frac{1}{1000}$ in. on lower scale and $\frac{1}{128}$ in. on upper scale. It is priced at $23.75.

Kodak Linagraph Direct Print Paper is a new photo-recording paper which provides an immediate visible record of instrumentation test data. The paper has been made to supply data on in-flight missiles within 10 seconds after phenomena under observation take place. Additional information is available from Graphic Reproduction Sales Div., Eastman Kodak Co., Rochester 4, N.Y.

"Kodak Materials for Overhead Projection," is a new Eastman Kodak Co. folder, describing simple photographic procedures by which transparencies can be prepared for use in overhead projectors. The 4-page illustrated leaflet covers such subjects as positive transparencies from line originals on translucent stock, transparencies from originals on opaque stock, negative transparencies, changing the size of an original subject, adding color to transparencies, and making duplicate slides. The leaflet is available without charge from Sales Service Div., Eastman Kodak Co., Rochester 4, N.Y.

Photodrawings, a 12-page Eastman Kodak booklet describing the use of photodrawings for aiding engineering visualization, is of special interest to draftmen, engineers and industry production men. In using this technique, photographs are reproduced on a translucent material on which engineering detail and superimposed sketches can be added. From this master photodrawing, work prints can be made by conventional processes. The booklet contains sections on making the picture negative, equipment and materials needed, making the master photodrawing, direct process reproduction, halftone methods, continuous tone methods, composite methods, blueprint reproduction and lithographic reproduction. The booklet (P-22) is available at no charge by writing Sales Service Division, Eastman Kodak Co., Rochester 4, N.Y.

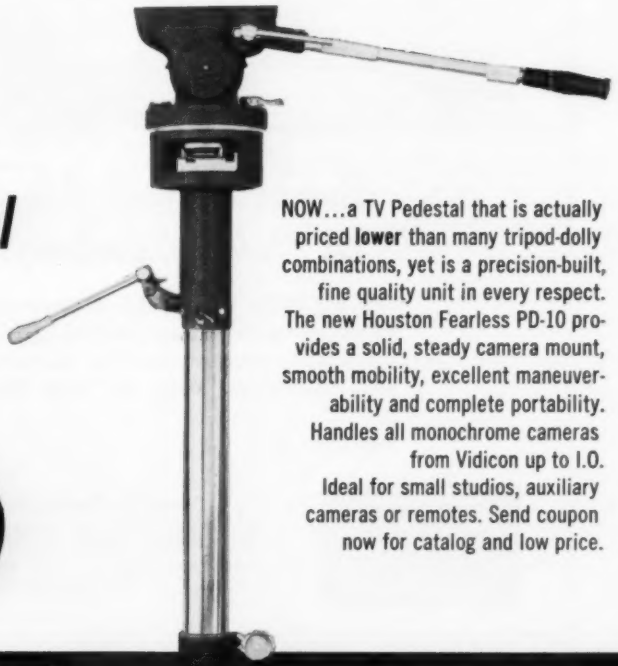
Simplex projectors, sound systems and accessories are now manufactured in the plants of General Precision Laboratory, Pleasantville, N.Y. Manufacturing operations of the GPL subsidiary, Simplex Equipment Corp., Bloomfield, N.J., are being suspended March 31, 1958. Simplex headquarters and a number of key personnel are being transferred to Pleasantville.

A new series of National Projector Carbon Bulletins has been announced by National Carbon Co., 30 E. 42 St., New York 17. Issued quarterly, the illustrated bulletins contain operating data, screen illumination tables, characteristics and optics of various types of projector lamps and other information. The bulletins are available without charge to projectionists. Requests should be addressed to the company to the attention of C. G. Ollinger. A ring binder is supplied with the first bulletin.

Fairchild Camera and Instrument Corp., Robbins Lane, Syosset, L.I., N.Y., has integrated its Reconnaissance Systems and Electronics Divisions into a new Defense Products Division. Charles J. O'Donnell has been appointed General Manager of the new division. He was formerly General Manager of the Reconnaissance Systems Division. Raul H. Frye, who headed the Electronics Division, has been named Assistant General Manager in charge of marketing and sales.

NEW

A Precision Quality Portable TV Pedestal At a Low Price!



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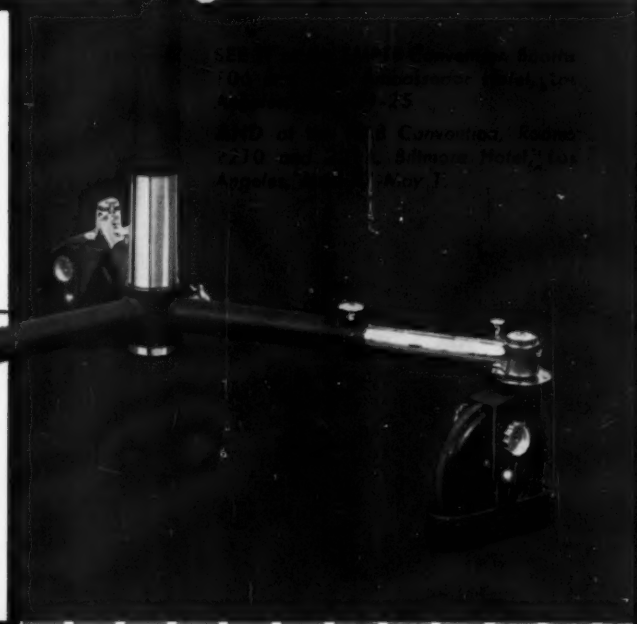
NOW...a TV Pedestal that is actually priced **lower** than many tripod-dolly combinations, yet is a precision-built, fine quality unit in every respect. The new Houston Fearless PD-10 provides a solid, steady camera mount, smooth mobility, excellent maneuverability and complete portability. Handles all monochrome cameras from Vidicon up to I.O. Ideal for small studios, auxiliary cameras or remotes. Send coupon now for catalog and low price.

Hydraulic jack quickly, easily raises or lowers pedestal. Maximum height to top of center column: 60". Minimum: 35".

PD-10 rolls smoothly, quietly on large, 8" rubber-tired, ball-bearing wheels. Cable guards are easily adjustable.

Swivel wheels can be locked in parallel for dolly shots or left free for maneuverability.

Telescoping legs can be extended for maximum stability or shortened for narrow passageways. Lock securely in position.



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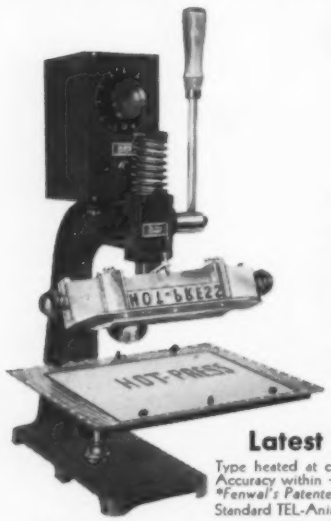

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Positions Wanted

Sound Engineer. Four yr experience in electronics. One yr experience as sound engineer for motion-picture producer. Married. Age 21. Write Sherald F. Brownrigg, 916 S. Glasgow Dallas 23, Texas.

Film Maker. Young man 25, with college background in documentary film production recent radio-TV experience with large ad agency, and recent experience in live TV, desires position with film producer in USA or abroad. Will send documentary films with screen credits, resume, scripts and film clips representing proficiency in camera, editing, screenwriting and client relations. Own light 16mm equipment and, through necessity, have become whiz at improvising low-budget staging, set-ups and special effects. Write B.K., 2109 W. Keeney, Evanston, Ill.

Motion Pictures. Argentine, age 43, married, relocating permanently in U. S., seeks position with opportunity for advancement, preferably in California. 23 yr experience in photography, 12 yr teaching at government school; head of motion-picture dept. of local engineering college; familiar with most technical problems; lineal drawing; degree in optics; writer for photog. magazines; workable knowledge English language. Would prefer work in color lab but would consider other positions. For detailed information write or cable: Juan Esnaola, Lagos 1210, Rosario, Argentina.

Motion Pictures. Position desired in professional motion-picture industry. Graduate Rochester Institute of Technology in May 1958, B.S. in Photographic Science. Chairman R.I.T. Student Chapter of SMPTE. Background in physics, optics, sensitometry, chemistry, photography, etc. Veteran. Resume on request. Stan A. Feigenbaum, 207 S. Plymouth Ave., Rochester 8 N. Y.

Engineer-Photographic. Extensive experience in design and development of military and consumer opto-electromechanical photographic products and instrumentation. Capable of assuming complete responsibility from creative inception to acceptable prototype. Experience in manufacturing procedures, design simplicity

and parts interchangeability. Seeking project assignment or part-time engagement. Foto, 495 Hempstead Turnpike, W. Hempstead, N. Y.

Administrative Engineer. The SMPTE's former Staff Engineer, Henry Kogel, is seeking a new position, after 6 years working with SMPTE Engineering Committees and the motion-picture standards program; also serving as Secy, American Standards Assn. Sec. Committee PH22, and Tech. Secy, International Standardization Orgn. Tech. Com. 36, Cinematography; 2 years, previously, develop. engr. with Sperry Gyroscope Co.; B.S. Elec. Eng., Columbia Univ., 1948, after military service as radio off.; recently sales engineer with Century Lighting Inc.; age 38; married; complete resume upon request. Henry Kogel, 19–24 202 St., Bayside 60, N.Y.; Tel. BAyside 9-3574.

Film Editor and TV Production Supervisor. 21 yr experience in production of theatricals, industrials, trailers and TV commercials, covering all phases of film production. Desire permanent position with New York organization. Resume on request. Write William E. Kosh, 22 Willets Ave., Syosset, L.I. Tel: Walnut 1-4656, Plaza 7-6034.

Producer Cameraman — TV and Motion Pictures. 15 yr experience in motion pictures, 6 yr producing TV commercials. Desires position with active organization in motion-picture or TV production. Used to hard work and responsibility. Age 38, currently employed by large mfr. Write or call Edward A. "Jack" Price, 2417 Crest Ave., South Bend, Ind. Tel: AT 9-6839.

Industrial Photographer, Cameraman, Producer. Broad experience in still and motion-picture production, camera, editing, darkroom color processing and printing, etc. Long working practice in industrial, commercial, educational, medical and documentary fields. Have produced hundreds b&w and color films. Knowledge of production and use of audio-visual media. Excellent background, master's degree; ambitious and reliable; perfect Spanish. Able to manage production unit. Have some equipment. Will travel or relocate. Write M.G., 68-46 Groton St., Forest Hills 75, N. Y.

Cameraman-Editor and Production Man wishes position with industrial, educational or commercial film producers. B.A. Univ. Miami in radio-TV-film productions. Worked as news cameraman and editor for local TV station. Presently employed as editor and assistant cameraman with producers of industrial films and TV commercials. Married, one child, willing to relocate. Read, write, speak Spanish. Resume available. Write: Sidney Platt, 300 S.W. 31 Ave., Miami 35, Fla.

Writer-Director-Editor. Experienced in all phases film production, from dealing with sponsors to negative cutting. Have written and/or edited theatrical, television and industrial films. Considerable experience in sound recording and dubbing. Educational background includes work at Cornell, Columbia and USC Dept of Cinema. Desires permanent position with New York industrial film company. Resume on request. Write: E. S. Seeley, Jr., 91 Remsen St., Brooklyn 1, N.Y. Tel: ULster 2-1037.

Motion-Picture Engineer. Formerly Technical Supervisor, The Michael Todd Co., Inc. Expert all technical phases motion-picture production and exhibition. Specialized work with all wide-screen systems now in use. Professional background includes responsible positions in production and exhibition with: The Todd-AO Corp., NBC-TV, CBS-TV Newsfilm, 20th Century Fox, RCA Victor, Altec Service Corp. and others. Qualified engineering draftsman. College major: Radio-TV-Motion-Pictures. Age: 32; health: excellent. Seeking interesting, challenging position. Presently employed motion-picture recording. Willing to relocate. Carl E. Warner, 141–60 84th Rd., Jamaica 35, N.Y. Tel: Hickory 1-3357.

Positions Available

Design Engineer. Responsible for product design of new products in field of photog. and meteorological instrumentation based on specification and design parameters supplied. Must have: degree in mech. eng., knowledge of electrical and electronic principles desirable; 3 yr exp. product design or detailed board design in optical or photog. instrumentation and/or mech. or mech.-electrical instrumentation and/or precision devices for low to medium production volume; 1 yr prod. eng. or equiv. exp. in eng. liaison, prod. prototype planning or testing; considerable knowledge machine tools, sand and die casting techniques, material finishing processes, standard fasteners, bearings and other mech. hardware. U. S. citizen. Salary: $650–850 per month. Write: George Bingham, Beckman & Whitley, Inc., 973 San Carlos Ave., San Carlos, Calif.

Development Engineer. Responsible for creative engineering, development tests and experimental design of proposed products. Must have: degree in mech. eng. or eng. physics; thorough knowledge theoretical and applied eng. principles in mechanics, materials, optics, and some electronics; 2 yr exp. with optical devices and/or mech. or mech.-electrical instruments and/or cameras or photog. instrumentation; 3 yr exp. in development or research on precision mech. or elect. devices; high degree creative eng. ability, ability to perform detailed math. analysis of applied eng. problems and outstanding record of performance. U. S. citizen. Salary: $650–800 per month. Write: George Bingham, Beckman & Whitley, Inc., 973 San Carlos Ave., San Carlos, Calif.

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Mechanical-Optical Engineer. Must have M.E. background with extensive and intimate knowledge of long focal length optics. Work will involve evaluation and improvement of large tracking telescopes and other optical systems used in missile range instrumentation. Applicants should have the educational and experience background to assume heavy project responsibilities. Salary commensurate with capability, plus outstanding bonus arrangement. Positions are located at Air Force Missile Development Center, Holloman, New Mexico, 10 miles southwest of Alamogordo, N.M. Contact W. F. Goodwin, Personnel Administrator, Land-Air, Inc., Box 394, Holloman, N.M.

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Contents — pages 177 - 224

News Columns

83d Convention 177

SMPTE Color TV Test Slides 177

ADVANCE PROGRAM 178

Education, Industry News 200

Section Reports 204

BOOKS REVIEWED 208

Underwater Photography, Enlarged 2d ed., by Hulbert Schenck, Jr., and Henry Kendall, reviewed by Fred Anderegg; *Tape Recorder Manual, Vol. 1, Automatic Record Changer Manual, Vol. 10.*

New Products 210

Employment Service 222

Advertisers

Animation Equipment Corp. 205

Baldwin Instrument Co., Ltd. 210

Bell & Howell Co. 186

Berndt-Bach, Inc. 179

Byron, Inc. 224

Camera Equipment Co. 191

Camera Mart, Inc. 203

Canadian Applied Research, Ltd. 187

Oscar F. Carlson Co. 199

Cinekad Engineering Co. 206

Classified 222

D'Arcy Magnetic Products, Inc. 200

Electro-Mechanical Development Co. 218

Electronic Systems, Inc. 201

Filmeffects of Hollywood 206

Filmline Corp. 200

Fish-Schurman Corp. 202

Florman & Babb 216

General Film Laboratories, Inc. 217

Geraetebau-Anstalt Balzers 188

Frank Herrnfeld Engineering Corp. 208

Hollywood Film Co. 184, 185

Houston Fearless Corp. 221

Philip A. Hunt Co. 207

Kinevox-Hallen Div. 180

Kling Photo Corp. 181, 219

La Vezzi Machine Works 223

Magnasync Mfg. Co., Ltd. 189

Metropolitan Electric Mfg. Co. 193

Motion Picture Laboratories, Inc. 204

Motion Picture Printing Equipment Co. 197

Movielab Color Corp. 183

Peerless Film Processing Corp. 192

Permafilm, Inc. 198

Photo Research Corp. 220

Precision Laboratories, Inc. 196

Prestoseal Mfg. Corp. 214

Professional Services 212

RCA Film Recording 211

Reeves Soundcraft Corp. 213

SMPTE 190

S.O.S. Cinema Supply Corp. 222

Southwest Film Laboratory, Inc. 222

Sylvania Electric Products, Inc. 194, 195

Technicolor Corp. 215

Tri Art Color Corp. 209

Westrex Corp. 182

Meeting Calendar

IRE National Convention, Mar. 24–27, New York.

Inter-Society Color Council, 27th Annual Meeting, Mar. 25–26, Sheraton-Park Hotel, Washington, D. C.

Optical Society of America, Mar. 27–29, Sheraton-Park Hotel, Washington, D. C.

Microwave Research Institute, Polytechnic Institute of Brooklyn, Symposium on Electronic Waveguides, Apr. 8–10, Engineering Societies' Bldg., 33 West 39th St., New York.

IRE, AIEE, ASME, Conference on Automatic Techniques, Apr. 14–16, Statler Hotel, Detroit.

83rd Semiannual Convention of the SMPTE, including Equipment Exhibit, April 21–26, Ambassador Hotel, Los Angeles.

PGCP, AIEE, EIA, WCEMA, Electronic Components Symposium, Apr. 22–24, Ambassador Hotel, Los Angeles.

Electrochemical Society, Apr. 27–May 1, Statler Hotel, New York.

National Academy of Sciences, Annual Meeting, Apr. 28–30, Washington, D. C.

NAB, 36th Annual Convention, Apr. 28–May 1, Biltmore & Statler Hotels, Los Angeles.

Professional Group on Microwave Theory and Techniques, National Symposium, May 5–7, Stanford U., Stanford, Calif.

Acoustical Society of America, Spring Meeting, May 7–9, Washington, D. C.

Society of American Military Engineers, 38th Annual Meeting, May 20–21, Washington, D. C.

Armed Forces Communications and Electronics Association, National Convention, June 4–6, Sheraton Park Hotel, Washington, D. C.

National Audio-Visual Association, Annual Convention, July 26–29, Morrison Hotel, Chicago.

WESCON, Aug. 19–22, Ambassador Hotel, Los Angeles.

Fourth International Congress on High-Speed Photography, including Equipment Exhibit, Sept. 22–27, Cologne.

Society of Photographic Scientists and Engineers, Annual Technical Conference, Oct. 6–10, Manger Rochester Hotel, Rochester, N.Y.

Optical Society of America, Oct. 9–11, Hotel Statler, Detroit, Mich.

National Electronics Conference, Oct. 13–15, Hotel Sherman, Chicago.

84th Semiannual Convention of the SMPTE, Oct. 20–24, Sheraton-Cadillac, Detroit.

American Standards Association, Ninth National Conference on Standards, Nov. 18–20, Hotel Roosevelt, New York.

Acoustical Society of America, Nov. 21–23, Chicago, Ill.

85th Semiannual Convention of the SMPTE, including International Equipment Exhibit, May 4–8, 1959, Fontainebleau, Miami Beach.

86th Semiannual Convention of the SMPTE, including Equipment Exhibit, Oct. 5–9, 1959, Statler, New York.

87th Semiannual Convention of the SMPTE, May 1–7, 1960, Ambassador Hotel, Los Angeles

88th Semiannual Convention of the SMPTE, Fall, 1960, Shoreham Hotel, Washington, D C.

89th Semiannual Convention of the SMPTE, Spring, 1961, Royal York, Toronto.

90th Semiannual Convention of the SMPTE, Oct. 15–20, 1961, Statler, New York.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections, Subsections and Chapters, and of the Committee Chairmen and Members will be published in the April 1958 Journal.

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